# OPERATOR'S MANUAL

# &

# INSTALLATION GUIDE

## WESTERBEKE CORPORATION
## DIESEL GENERATORS
## SINGLE AND THREE PHASE

### MODEL BTD 8.0 KW, 10.0 KW, 11.0 KW
### BTD & A 12.5 KW 60 HERTZ

### MODEL BTD 6.0 KW, 7.5 KW, 8.3 KW
### BTD & A 9.4 KW 50 HERTZ

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## SAFETY PRECAUTIONS

The following symbols appear in this manual to call attention to and emphasize conditions potentially dangerous to the operator.

*WARNING*

The above symbol is used in the manual to warn of possible serious personal injury or loss of life.

*CAUTION*

The above symbol is used in the manual to caution personnel of possible damage to equipment.

Read the manual carefully and thoroughly before attempting to operate the equipment. Know when dangerous conditions can exist and take necessary precautions to protect personnel and equipment.

Fuels, exhaust gases, batteries, electrical equipment, and moving and hot parts are potential hazards that could result in serious personal injury or death. Follow recommended procedures carefully.

Always operate bilge blowers for at least five minutes before starting a gasoline-fueled engine; ensure no gasoline fumes are present before starting.

- **Prevent Electric Shock**

  Shut off electric power before accessing electrical equipment.

  Use insulated mats whenever working on electrical equipment.

  Make sure your clothing is dry, not damp (particularly shoes), and keep your skin surfaces dry when handling electrical equipment.

  Remove wristwatch and jewelry when working on electrical equipment.

  Do not connect utility shore power to vessel's AC circuits, except through a ship-to-shore double throw transfer switch. Damage to vessel's AC generator may result if this is not done.

  Be extremely careful when working on electrical components. High voltage can cause injury or death.

- **Exhaust Gases Are Toxic**

  Ensure that exhaust system is adequate to expel gases discharged from the engine. Check exhaust system regularly for leaks and make sure the exhaust manifolds are securely attached and no warping exists.

  Be sure the unit and its surroundings are well-ventilated.

- **Use Extreme Care When Handling Engine Fuel(A constant danger of explosion or fire exists)**

  Do not fill fuel tank(s) while the engine is running.

  Do not smoke or use an open flame near the engine or the fuel tank.

- **Do Not Alter or Modify the Fuel System**

  Be sure all fuel supplies have a positive shut-off valve.

  Be certain fuel line fittings are adequately tightened and free of leaks.

  Make sure a fire extinguisher is installed nearby and is properly maintained. Be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.

- **Use Extreme Care When Servicing Batteries**

  Wear rubber gloves, a rubber apron, and eye protection when servicing batteries.

  Lead acid batteries emit hydrogen, a highly-explosive gas, which can be ignited by electrical arcing or by a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.

- **Avoid Moving Parts**

  Do not service the unit while it is running. If a situation arises in which it is absolutely necessary to make operating adjustments, use extreme care to avoid moving parts and hot exhaust system components.

  Do not wear loose clothing or jewelry when servicing equipment; avoid wearing loose jackets shirts or sleeves, rings, necklaces, or bracelets that might be caught in moving parts.

  Make sure all attaching hardware is properly tightened. Keep protective shields and guards in their respective place at all times.

  Do not check fluid levels or the drive belt's tension while the unit is operating.

  Do not work on the equipment when mentally or physically incapacitated by fatigue.

# FOREWORD

Thank you for selecting a Westerbeke marine product for your use. We at Westerbeke are pleased to have you as a customer.

Read this manual carefully and observe all safety precautions included throughout. Operating procedures, periodic preventive maintenance procedures, installation checks, system descriptions and minor adjustment procedures are included herein so you can operate your equipment safely and properly, maintain the equipment at a high level of efficiency, and expect dependable performance and long service life in return. Should your unit require special attention, contact your Westerbeke dealer for assistance. The Westerbeke Service Organization is trained to provide the support necessary to ensure long-term dependable performance.

If, within 60 days of submitting the Warranty Registration Form for your unit, you have not received a Customer Identification Card (see below) registering your warranty, please contact the factory in writing with Model information, including the unit's serial number and commission date.

## IMPORTANT

## PRODUCT SOFTWARE DISCLAIMER

Product software of all kinds, such as brochures, drawings, technical data, operator's and workshop manuals, parts lists and parts price lists, and other information, instructions and specifications provided from sources other than Westerbeke, is not within Westerbeke's control and, accordingly, is provided to Westerbeke customers only as a courtesy and service. WESTERBEKE CANNOT BE RESPONSIBLE FOR THE CONTENT OF SUCH SOFTWARE, MAKES NO WARRANTIES OR REPRESENTATIONS WITH RESPECT THERETO, INCLUDING ACCURACY, TIMELINESS OR COMPLETENESS THEREOF, AND WILL IN NO EVENT BE LIABLE FOR ANY TYPE OF DAMAGES OR INJURY INCURRED IN CONNECTION WITH, OR ARISING OUT OF, THE FURNISHING OR USE OF SUCH SOFTWARE.

For example, components and subassemblies incorporated in Westerbeke's products and supplied by others (such as engine blocks, fuel systems and components, transmissions, electrical components, pumps and other products) are generally supported by their manufacturers with their own software, and Westerbeke must depend on such software for the design of Westerbeke's own product software. Such software may be outdated and no longer accurate. Routine changes made by Westerbeke's suppliers, of which Westerbeke rarely has notice in advance, are frequently not reflected in the supplier's software until after such changes take place.

Westerbeke customers should also keep in mind the time span between printings of Westerbeke product software, and the unavoidable existence of earlier, non-current Westerbeke software editions in the field. Additionally, most Westerbeke products include customer-requested special features that frequently do not include complete documentation.

In summation, product software provided with Westerbeke products, whether from Westerbeke or other suppliers, must not and cannot be relied upon exclusively as the definitive authority on the respective product. It not only makes good sense but is imperative that appropriate representatives of Westerbeke or the supplier in question be consulted to determine the accuracy and currentness of the product software being consulted by the customer.

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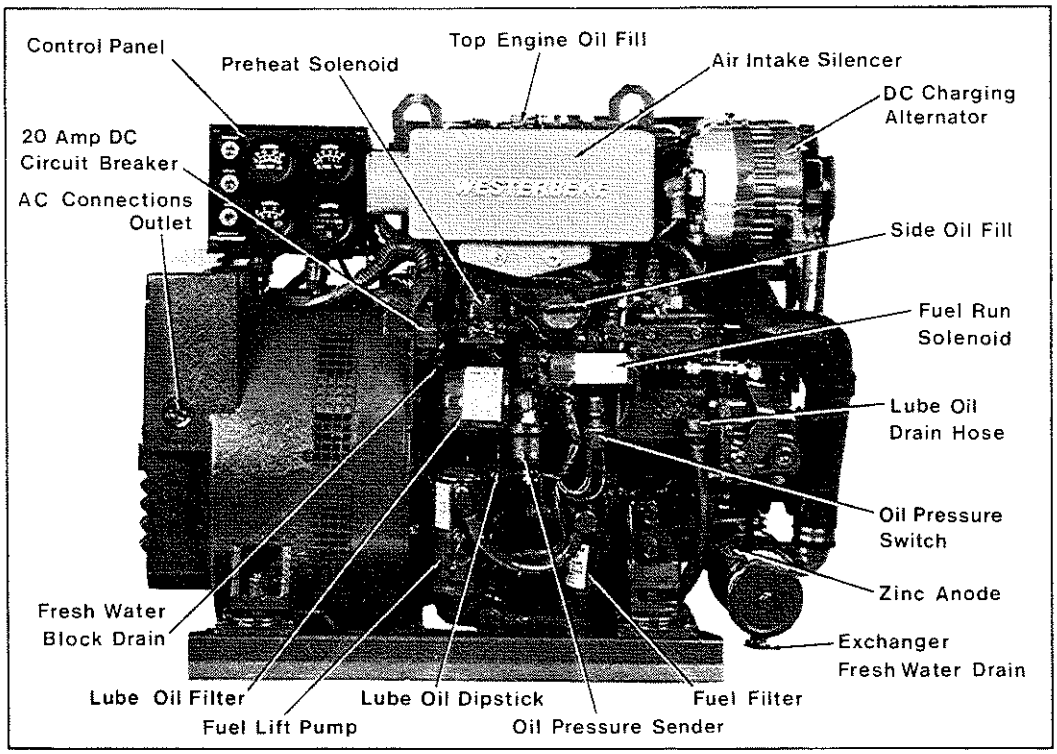
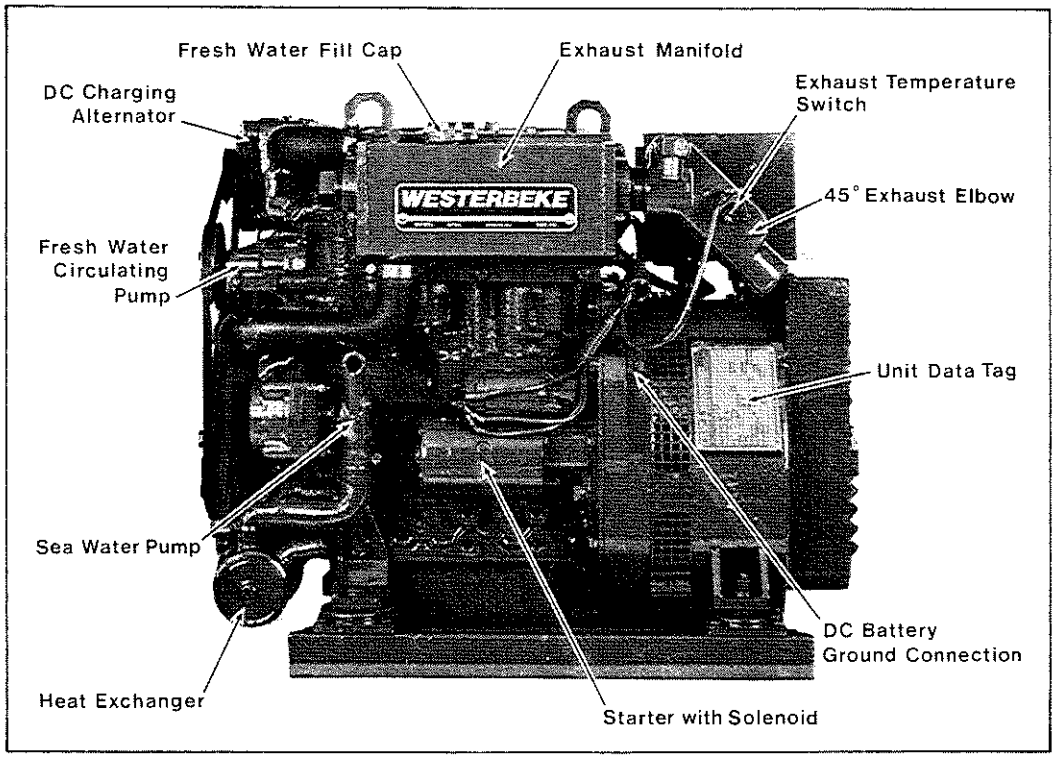
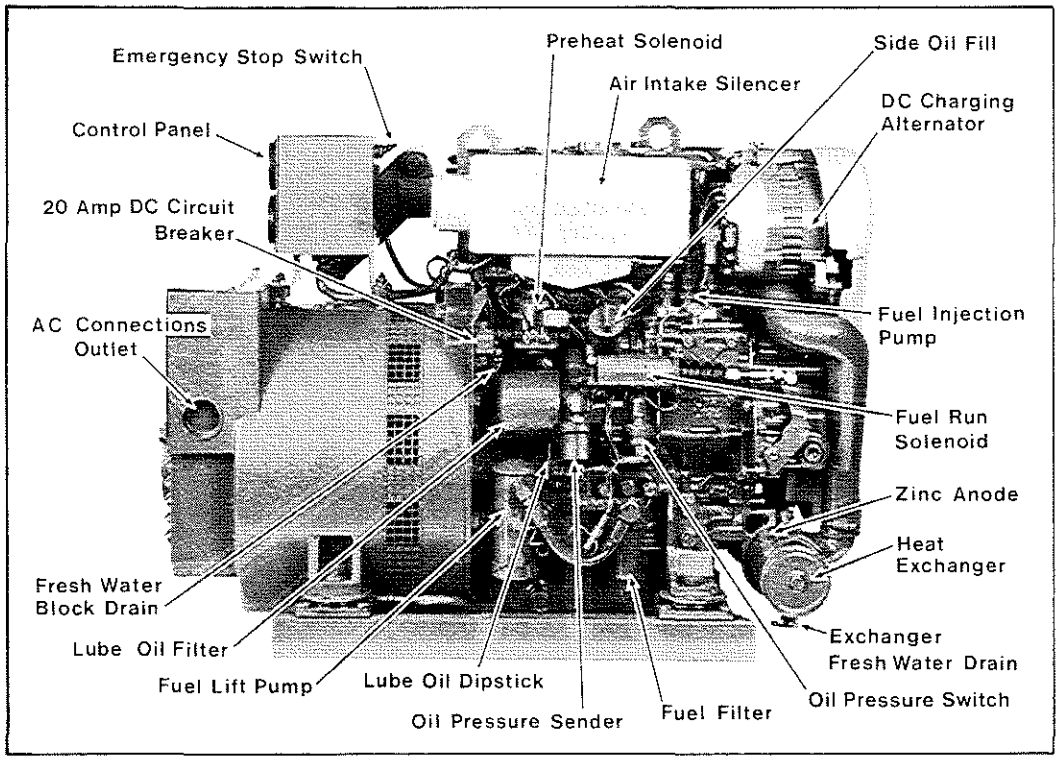



8.0 KW BTD

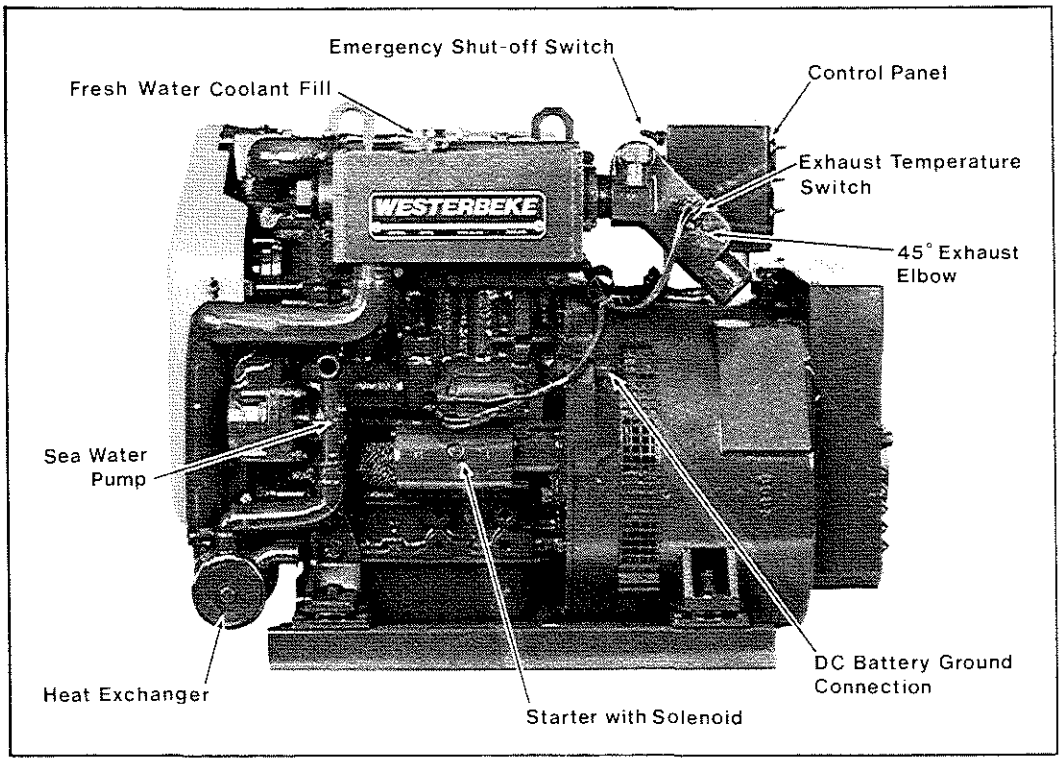



8.0 KW BTD

## BTD 10.0 KW Generator

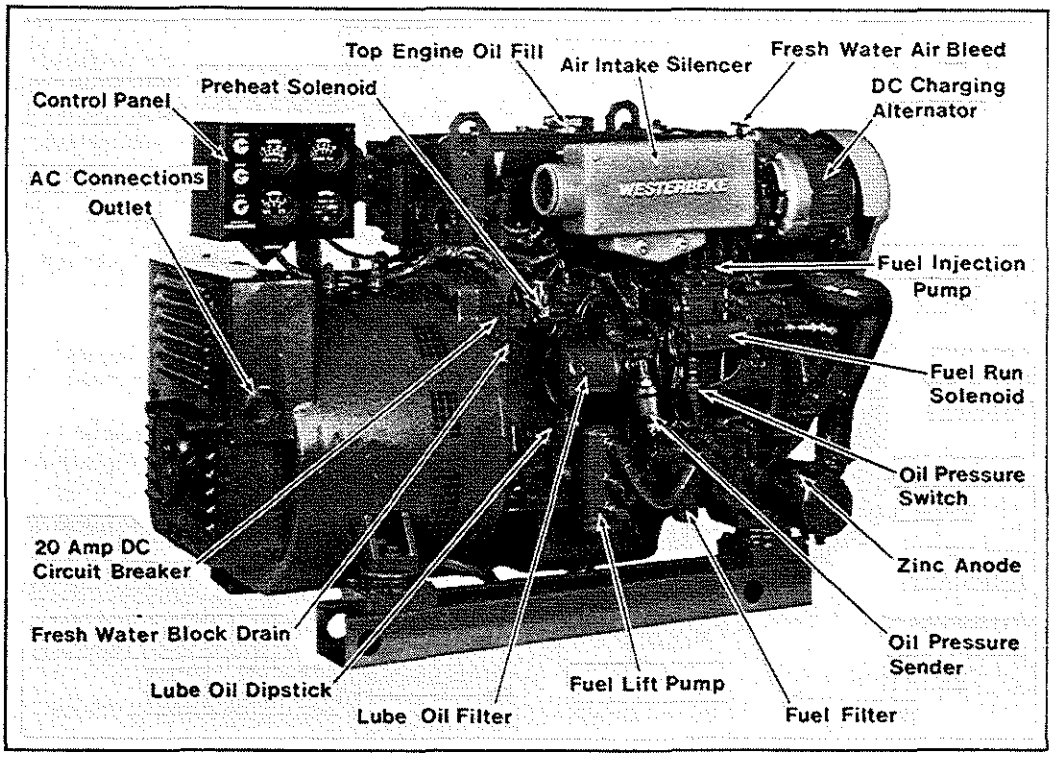



10.0 KW BTD

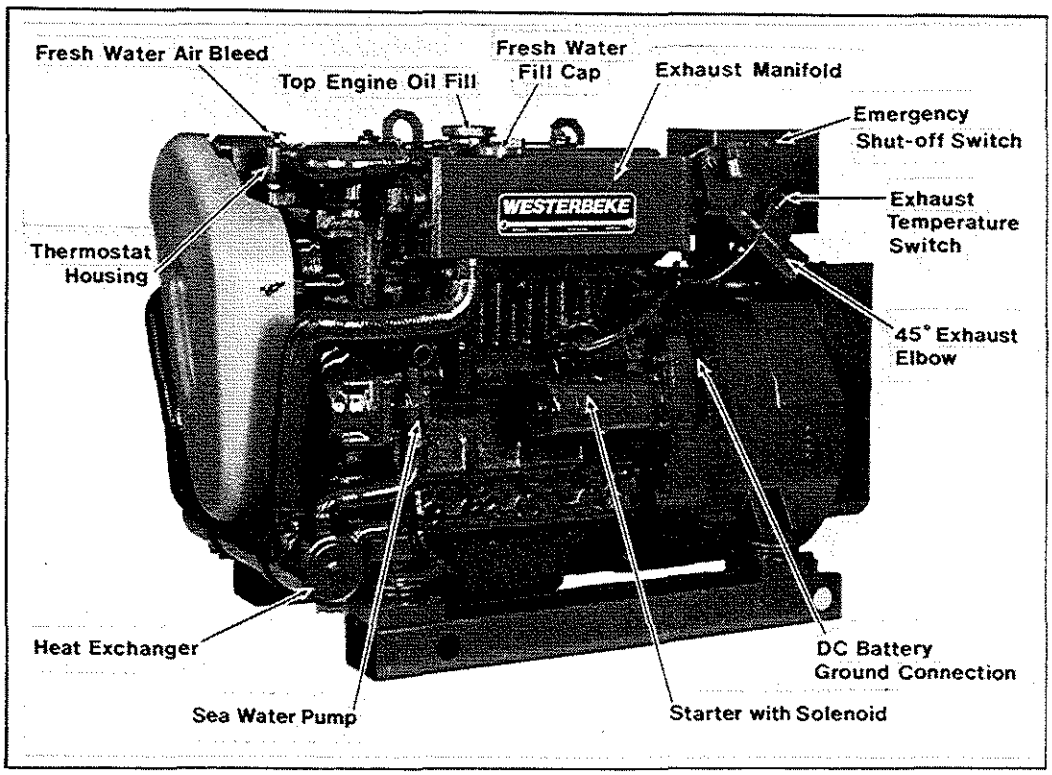



10.0 KW BTD

## BTD 11.0 KW Generator

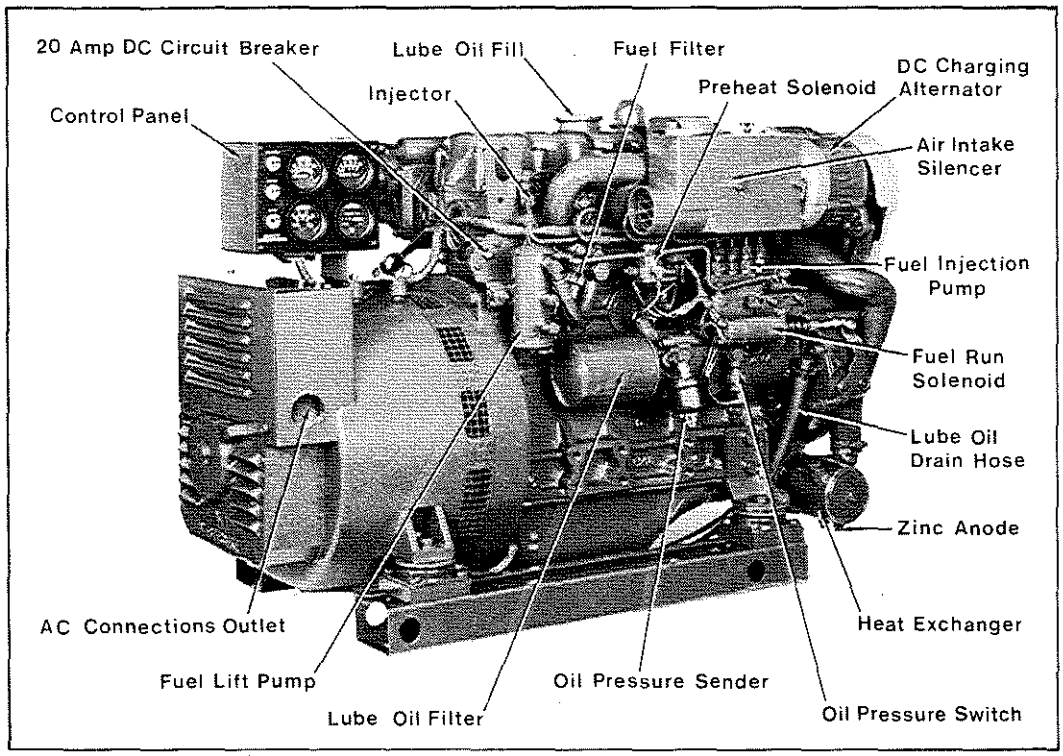



11.0 KW BTD

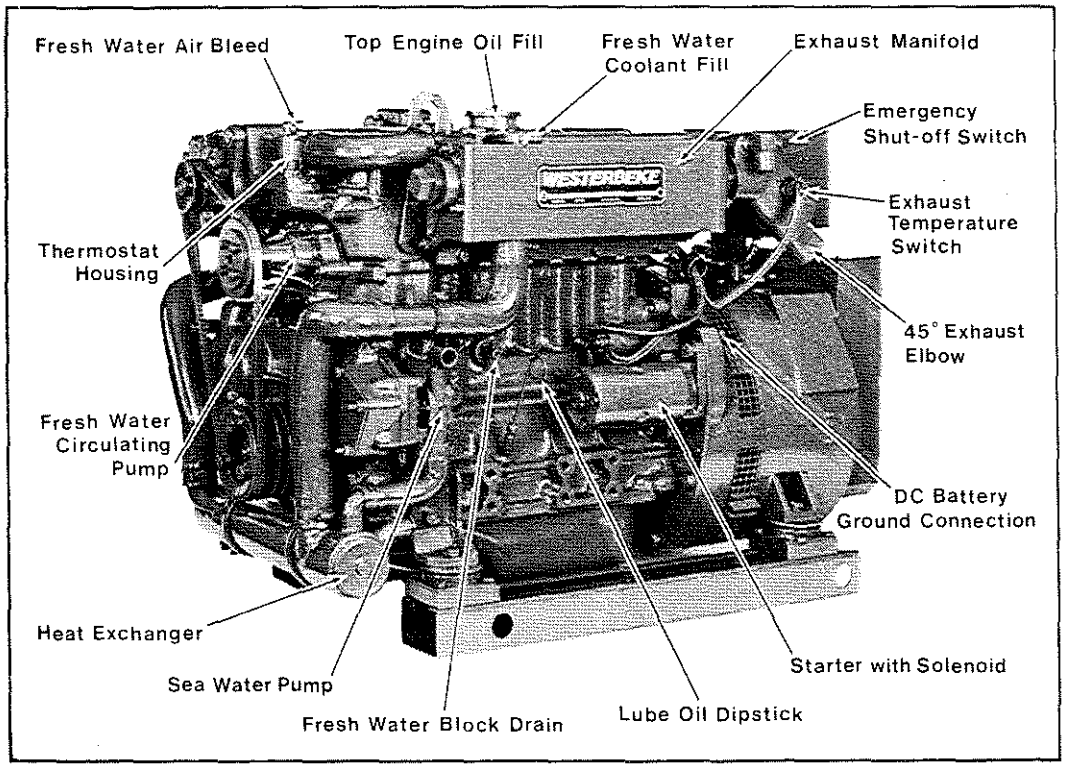


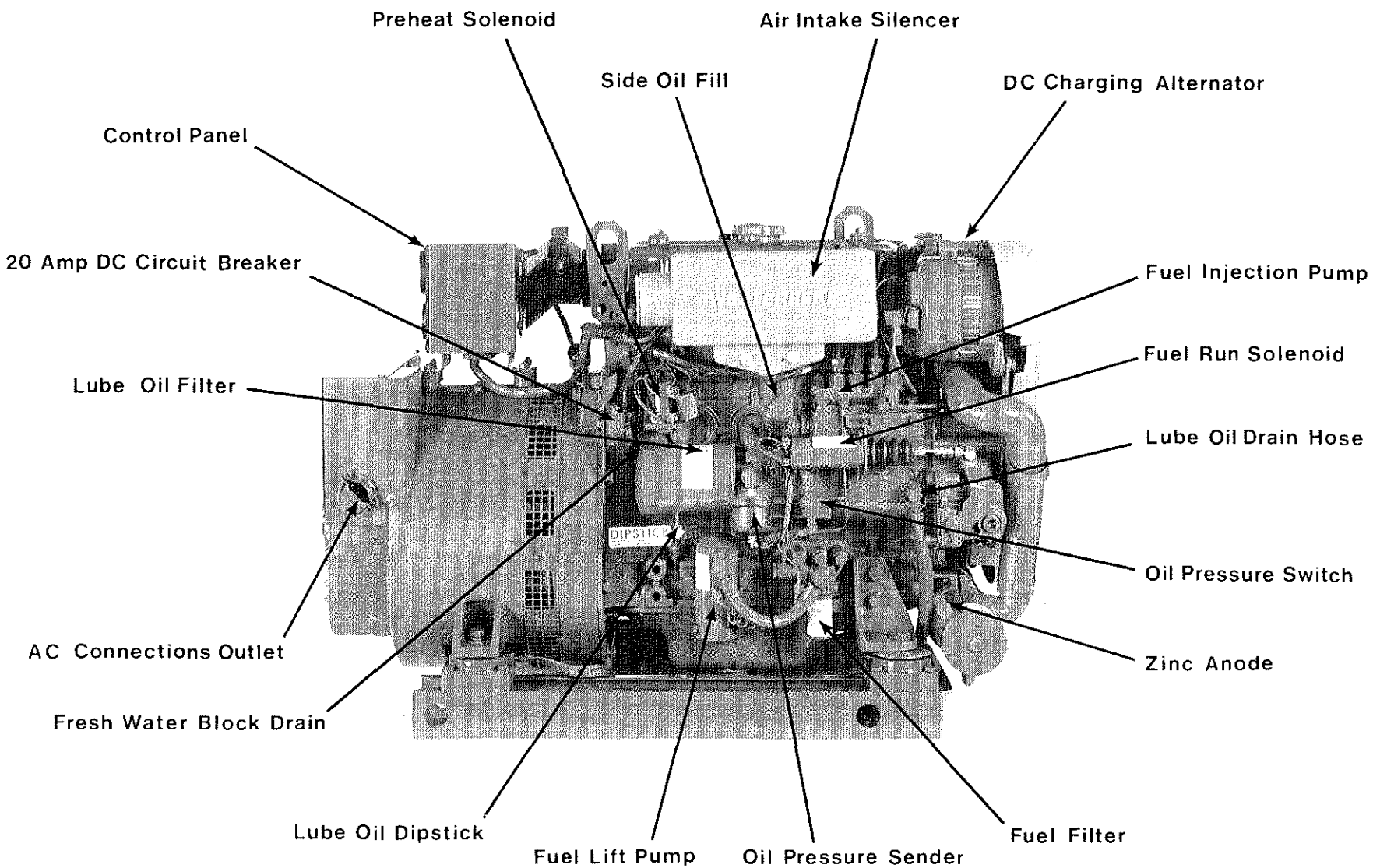

11.0 KW BTD

## BTD 12.5 KW Generator

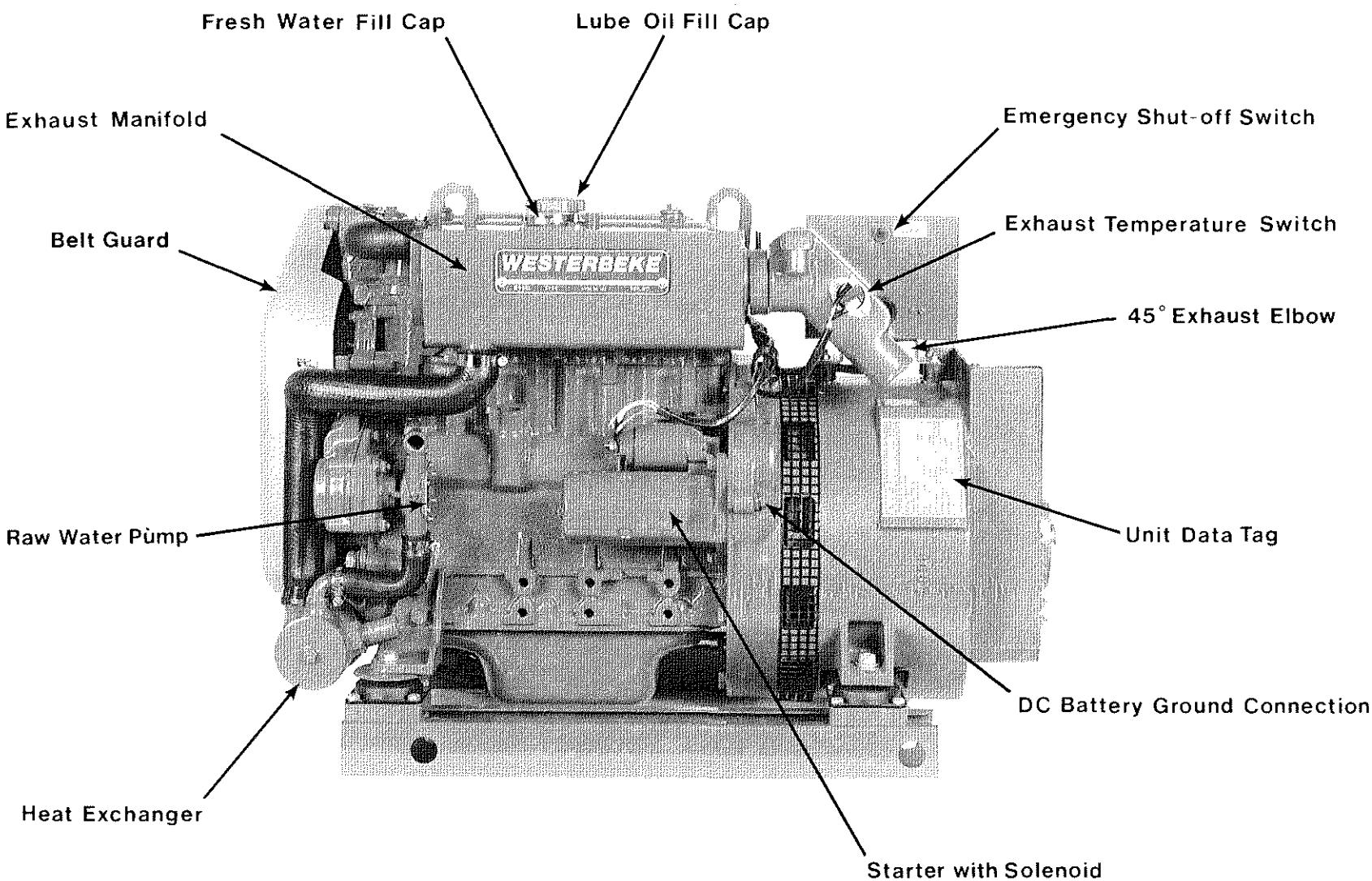



**12.5 KW BTD**






**12.5 BTDA**
RIGHT SIDE




**12.5 BTDA**
LEFT SIDE

# GENERAL

## Introduction

This manual contains the equipment operating procedures as well as additional information needed to help the operator keep the marine equipment in proper working order. Study and follow the instructions carefully. A planned maintenance program is included in this manual; adhering to the program will result in better equipment performance and longer equipment life. Proper diagnosis of a problem is the most important step to satisfactory repair; consequently, a troubleshooting table is included.

## Understanding the Diesel Engine

The diesel engine closely resembles the gasoline engine, since the mechanism is essentially the same. The cylinders are arranged above a closed crankcase; the crankshaft is of the same general type as that of a gasoline engine; and the diesel engine has the same type of valves, camshaft, pistons, connecting rods and lubricating system.

Therefore, to a great extent, a diesel engine requires the same preventive maintenance as a gasoline engine. The most important factors are proper ventilation and proper maintenance of the fuel, lubricating and cooling systems. Replacement of fuel and lubricating filter elements at the time periods specified is a must, and frequent checking for contamination (that is, water, sediment, etc.) in the fuel system is also essential. Another important factor is the use of the same brand of high detergent diesel lubricating oil designed specifically for diesel engines.

The diesel engine does differ form the gasonline engine, however, in its method of handling and firing of fuel. The carburetor and ignition systems are done away with and in their place is a single component - the fuel injection pump - which performs the function of both.

## Ordering Parts

When contacting your Westerbeke dealer, parts distributor, or the factory about your Westerbeke unit, always provide the generator's complete model number, the engine's serial number and the generator's serial number as they appear on the black and silver nameplate located on the generator end. You must provide us with this information so we may properly identify your unit.

Note that component locations in the manual are referenced from the front of the engine which is the pulley/drive belt end. (The flywheel/generator or transmission end is the rear end.) Left and right sides are determined by the engine; imagine straddling the engine and facing in the same direction as the front of the engine: the left side is at your left, the right side at your right.

Westerbeke engines and generator sets are thoroughly checked and given a final run under various load conditions before leaving the factory. This is done to ensure dependable operation, long service, and a satisfied owner.

Care at the factory during assembly, and thorough testing, have resulted in a Westerbeke diesel engine driven generator capable of many thousands of hours of dependable service. However, the manufacturer cannot control the treatment the unit receives in the field. That part is up to the owner/operator.

## BTD 8.0 KW MARINE DIESEL GENERATOR SET GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | Diesel, 4-cycle, 3-cylinder, fresh water-cooled<br>Vertical, in-line overhead valve mechanism<br>(14 hp at 1800 rpms maximum) |
| Governor | Mechanical, centrifugal weight type |
| Combustion Chamber | Swirl chamber type |
| Bore & Stroke | 2.87 × 3.07 inches (73 × 78 mm) |
| Pistion Displacement | 60 cubic inches (0.979 liters) |
| Firing Order | 1-3-2 |
| Direction of Rotation | Clockwise, when viewed from the front |
| Maximum Torque (at 1800 rpm) | 41.50 lb-ft (5.73 kg-m) |
| Compression Ratio | 23 : 1 |
| Compression Pressure | 455.2 psi (32 kg/cm$^2$) at 280 rpm |
| Valve Timing | Intake Opens 18° BTDC<br>Intake Closes 46° ABDC<br><br>Exhaust Opens 46° BBDC<br>Exhaust Closes 18° ATDC |
| Valve Seat Angle | Intake 45°<br>Exhaust 45° |
| Valve Clearance<br>(engine cold) | Intake 0.0098 inches (0.25 mm)<br>Exhaust 0.0098 inches (0.25 mm) |
| Engine Speed | 1800 rpm 60 Hertz<br>1500 rpm 50 Hertz |
| Dimensions | Height: 21.80 inches (553.72mm)<br>Width: 17.00 inches (431.80 mm)<br>Length: 28.20 inches (716.28 mm) |
| Weight | 450 lbs (204.12 kgs) |
| Fuel Consumption | 0.9 gph (3.40 lph) at full rated<br>output (approximate) |
| Inclination | Continuous 15°<br>Temporary 20° (not to exceed 20 min.) |

## SYSTEM SPECIFICATIONS

***FUEL SYSTEM:***

| | |
|---|---|
| GENERAL | Open flow, totally self-bleeding |
| FUEL | No. 2 Diesel oil (cetane rating of 45 or higher) |
| FUEL INJECTION PUMP | Nippon Denso (Bosch M type) |
| FUEL INJECTION TIMING | 19° BTDC ±0.5 (static timing) |
| NOZZLE<br>INJECTORS | Throttle type<br>Pintle type |
| FUEL PUMP<br>FUEL FILTER(on engine) | 12-Volt DC; Electro-Magnetic type<br>Canister type, with replaceable element |
| AIR CLEANER | Metal-screen type |
| AIR FLOW | 32 cfm (.906 cmm) |

***COOLING SYSTEM:***

| | |
|---|---|
| GENERAL | Closed fresh water-cooled block, thermostatically controlled with heat exchanger. |
| OPERATING TEMPERATURE | 170° - 190° F (77° - 88° C) |
| FRESH WATER PUMP | Centrifugal type, metal impeller, belt-driven |
| SEA WATER PUMP | Positive displacement, rubber impeller, belt-driven |
| SEAW WATER FLOW, AT 1800 RPM (measured before discharging into exhaust elbow.) | 8.5 gpm (32.2 lpm) |
| SYSTEM CAPACITY(Fresh Water) | 5 quarts (4.73 liters) |

***LUBRICATION SYSTEM:***

| | |
|---|---|
| GENERAL | Pressure type by Trichoid pump, gear driven with external pressure relief valve |
| OIL FILTER | Full flow, paper element, spin-on type |
| SUMP CAPACITY | 3.3 quarts (3.12 liters) |
| OPERATING OIL PRESSURE (engine hot) | 40 - 80 psi (2.8 - 5.6 $kg/cm^2$) |
| OIL GRADE | API specification CC or CD |

## SYSTEM SPECIFICATIONS CONTINUED...

### *ELECTRICAL SYSTEM*

| | |
|---|---|
| STARTING BATTERY | 12-Volt, ( - ) negative ground |
| BATTERY CAPACITY | 300-400 CCA |
| DC CHARGING ALTERNATOR | 12-volt DC, 50 Amp |
| REGULATOR | Internal regulator built into alternator |
| STARTING AID | Glow Plug, sheathed type |
| STARTER | 12-volt, 1.2 KW, reduction type, solenoid mounted |
| DC NO-LOAD CURRENT | 90 Amp (max.) at 11.5 Volts |
| DC CRANKING CURRENT | 175 - 200 Amps (engine cold) |

### *AC GENERATOR*

| | |
|---|---|
| GENERAL | Brushless, four-pole, revolving field.<br>Pre-lubricated single-bearing design.<br>Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation) |
| VOLTAGE | 120 or 120/240 Volts - 60 Hertz<br>220 Volts - 50 Hertz<br>Voltage regulation:± 5 % no load to full load<br>Frequency regulation: ± 3 % Hertz (5%) no load to full load |

RATING (Volts AC)

| | | |
|---|---|---|
| 60 HERTZ (1800 rpm)<br>8.0 KW | 120 Volts<br>120/240 Volts | 66 Amps<br>66/33 Amps |
| 50 HERTZ (1500 rpm)<br>6.0 KW | 220 Volts | 27 Amps |

| | |
|---|---|
| GENERATOR COOLING AIR REQUIREMENTS, (60 Hertz), at 1800 rpm | 175 - 200 cfm (4.95 - 5.66 cmm) |

**NOTE: Increase air supply 15 % for 50 Hertz operation 1500 rpm.**

## SYSTEM SPECIFICATIONS CONTINUED...

| | |
|---|---|
| ENGINE COMBUSTION AIR REQUIREMENTS (60 Hertz) AT 1800 rpm | 32 cfm (.906 cmm) |
| ENGINE COMPARTMENT COOLING AIR | 100-200 cfm (2.83 - 5.66 cmm) |

***TUNE UP SPECIFICATIONS***

| | |
|---|---|
| INJECTOR PRESSURE | 1707 psi (120 $kg/cm^2$ + 10 $kg/cm^2$ - 0 $kg/cm^2$) |
| ENGINE TIMING | 19° BTDC |

## BTD 10.0 KW MARINE DIESEL GENERATOR SET GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | Diesel, 4-cycle, 3-cylinder, fresh water-cooled<br>Vertical, in-line overhead valve mechanism<br>(16.5 hp at 1800 rpms maximum) |
| Governor | Mechanical, centrifugal weight type |
| Combustion Chamber | Swirl chamber type |
| Bore & Stroke | 3.07 × 3.07 inches (78 × 78 mm) |
| Pistion Displacement | 68 cubic inches (1.12 liters) |
| Firing Order | 1-3-2 |
| Direction of Rotation | Clockwise, when viewed from the front |
| Maximum Torque (at 1800 rpm) | 47.7 lb-ft (6.6 kg-m) |
| Compression Ratio | 23 : 1 |
| Compression Pressure | 483.5 psi (34 kg/cm$^2$) at 230 rpm |
| Valve Timing | Intake Opens 18° BTDC<br>Intake Closes 46° ABDC<br><br>Exhaust Opens 46° BBDC<br>Exhaust Closes 18° ATDC |
| Valve Seat Angle | Intake 45°<br>Exhaust 45° |
| Valve Clearance<br>(engine cold) | Intake 0.0098 inches (0.25 mm)<br>Exhaust 0.0098 inches (0.25 mm) |
| Engine Speed | 1800 rpm 60 Hertz<br>1500 rpm 50 Hertz |
| Dimensions | Height: 22.00 inches (558.7mm)<br>Width: 16.85 inches (427.9 mm)<br>Length: 32.56 inches (827.02 mm) |
| Weight | 495 lbs (224.5 kgs) |
| Fuel Consumption | 1.0 gph (3.78 lph) at full rated<br>output (approximate) |
| Inclination | Continuous 15°<br>Temporary 20° (not to exceed 20 min.) |

## SYSTEM SPECIFICATIONS

***FUEL SYSTEM:***

| | |
|---|---|
| GENERAL | Open flow, totally self-bleeding |
| FUEL | No. 2 Diesel oil (cetane rating of 45 or higher) |
| FUEL INJECTION PUMP | Nippon Denso (Bosch M Type) |
| FUEL INJECTION TIMING | 19° BTDC ±0.5 (static timing) |
| NOZZLE<br>INJECTORS | Throttle type<br>Pintle type |
| FUEL PUMP<br>FUEL FILTER(on engine) | 12-Volt DC; Electro-Magnetic type<br>Canister type, with replaceable element |
| AIR CLEANER | Metal screen type-cleanable |
| AIR FLOW | 48 cfm (1.36 cmm) |

***COOLING SYSTEM:***

| | |
|---|---|
| GENERAL | Closed fresh water-cooled block, thermostatically controlled with heat exchanger. |
| OPERATING TEMPERATURE | 170° - 190° F (77° - 88° C) |
| FRESH WATER PUMP | Centrifugal type, metal impeller, belt-driven |
| SEA WATER PUMP | Positive displacement, rubber impeller, belt-driven |
| SEAW WATER FLOW, AT 1800 RPM (measured before discharging into exhaust elbow.) | 7.2 gpm (27.25 lpm) |
| SYSTEM CAPACITY(Fresh Water) | 8 quarts (7.6 liters) |

***LUBRICATION SYSTEM:***

| | |
|---|---|
| GENERAL | Pressure type by Trichoid pump, gear driven with external pressure relief valve |
| OIL FILTER | Full flow, paper element, spin-on type |
| SUMP CAPACITY | 4.76 (4.5 liters) |
| OPERATING OIL PRESSURE (engine hot) | 40 - 80 psi (2.8 - 5.6 kg/cm$^2$) |
| OIL GRADE | API specification CC or CD |

## SYSTEM SPECIFICATIONS CONTINUED...

### *ELECTRICAL SYSTEM*

| | |
|---|---|
| STARTING BATTERY | 12-Volt, ( - ) negative ground |
| BATTERY CAPACITY | 350-450 CCA |
| DC CHARGING ALTERNATOR | 12-volt DC, 50 Amp |
| REGULATOR | Internal regulator built into alternator |
| STARTING AID | Glow Plug, sheathed type |
| STARTER | 12-volt, 1.6 KW, reduction type, solenoid mounted |
| DC NO-LOAD CURRENT | 90 Amp (max.) at 11.5 Volts |
| DC CRANKING CURRENT | 175 - 200 Amps (engine cold) |

### *AC GENERATOR*

| | |
|---|---|
| GENERAL | Brushless, four-pole, revolving field.<br>Pre-lubricated single-bearing design.<br>Reconnectable, single-phase transformer regulation<br>(optional solid-state voltage regulation) |
| VOLTAGE | 120 or 120/240 Volts - 60 Hertz<br>220 Volts - 50 Hertz<br>Voltage regulation:± 5 % no load to full load<br>Frequency regulation: ± 3 % Hertz (5%) no load to full load |

RATING (Volts AC)

| | | |
|---|---|---|
| 60 HERTZ (1800 rpm)<br>10.0 KW | 120 Volts<br>120/240 Volts | 83.3 Amps<br>83.3/41.6 Amps |
| 50 HERTZ (1500 rpm)<br>7.5 KW | 220 Volts | 34.1 Amps |

| | |
|---|---|
| GENERATOR COOLING AIR REQUIREMENTS, (60 Hertz), at 1800 rpm | 225-250 cfm (5.66 - 6.37 cmm) |

**NOTE: Increase air supply 15 % for 50 Hertz operation 1500 rpm.**

## SYSTEM SPECIFICATIONS CONTINUED...

| | |
|---|---|
| General - 3 Phase<br>10.0 KW - 60 Hertz<br>7.5 KW - 50 Hertz | Brushless six pole, revolving field. Sealed lubricated single bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid State voltage regulator with protection circuitry. |
| Voltage - 3 Phase (60 Hertz) | Low voltage WYE 208 volts<br>High voltage WYE 480 volts<br>DELTA 240 volts |
| Voltage - 3 Phase (50 Hertz) | High voltage WYE 380 volts<br>DELTA 220 volts |
| Amperage - 3 Phase (60 Hertz) | Low voltage WYE 35 Amps<br>High voltage WYE 15 Amps<br>DELTA 30 Amps |
| Amperage - 3 Phase (50 Hertz) | High voltage WYE 14 Amps<br>DELTA 24 Amps |

***AC GENERATOR :***

| | |
|---|---|
| ENGINE COMBUSTION AIR REQUIREMENTS (60 Hertz) AT 1800 rpm | 32 cfm (.906 cmm) |
| ENGINE COMPARTMENT COOLING AIR | 100-200 cfm (2.83 - 5.66 cmm) |

***TUNE UP SPECIFICATIONS***

| | |
|---|---|
| INJECTOR PRESSURE | 1707 psi (120 $kg/cm^2$ + 10 $kg/cm^2$ - 0 $kg/cm^2$) |
| ENGINE TIMING | 19° BTDC |

## BTD 11.0 KW MARINE DIESEL GENERATOR SET GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | Diesel, 4-cycle, 4-cylinder, fresh water-cooled<br>Vertical, in-line overhead valve mechanism<br>(18.4 hp at 1800 rpms maximum) |
| Governor | Mechanical, centrifugal weight type |
| Combustion Chamber | Swirl chamber type |
| Bore & Stroke | 2.87 × 3.07 inches (73 × 78 mm) |
| Pistion Displacement | 80 cubic inches (1.305 liters) |
| Firing Order | 1-3-4-2 |
| Direction of Rotation | Clockwise, when viewed from the front |
| Maximum Torque (at 1800 rpm) | 54 lb-ft (7.46 kg-m) |
| Compression Ratio | 23 : 1 |
| Compression Pressure | 455 psi (32 kg/cm$^2$) at 280 rpm |
| Valve Timing | Intake Opens 18° BTDC<br>Intake Closes 46° ABDC<br><br>Exhaust Opens 46° BBDC<br>Exhaust Closes 18° ATDC |
| Valve Seat Angle | Intake 45°<br>Exhaust 45° |
| Valve Clearance<br>(engine cold) | Intake 0.0098 inches (0.25 mm)<br>Exhaust 0.0098 inches (0.25 mm) |
| Engine Speed | 1800 rpm 60 Hertz<br>1500 rpm 50 Hertz |
| Dimensions | Height: 23.75 inches (603.25mm)<br>Width: 16.85 inches (427.99 mm)<br>Length: 34.56 inches (877.82 mm) |
| Weight | 575 lbs (260.8 kgs) |
| Fuel Consumption | 1.2 gph (4.54 lph) at full rated<br>output (approximate) |
| Inclination | Continuous 15°<br>Temporary 20° (not to exceed 20 min.) |

## SYSTEM SPECIFICATIONS

***FUEL SYSTEM:***

| | |
|---|---|
| GENERAL | Open flow, totally self-bleeding |
| FUEL | No. 2 Diesel oil (cetane rating of 45 or higher) |
| FUEL INJECTION PUMP | Nippon Denso (Bosch M type) |
| FUEL INJECTION TIMING | 19° BTDC ±0.5 (static timing) |
| NOZZLE<br>INJECTORS | Throttle type<br>Pintle type |
| FUEL PUMP<br>FUEL FILTER(on engine) | 12-Volt DC; Electro-Magnetic type<br>Canister type, with replaceable element |
| AIR CLEANER | Metal screen type-cleanable |
| AIR FLOW | 42 cfm (1.2 cmm) |

***COOLING SYSTEM:***

| | |
|---|---|
| GENERAL | Closed fresh water-cooled block, thermostatically controlled with heat exchanger. |
| OPERATING TEMPERATURE | 170° - 190° F (77° - 88° C) |
| FRESH WATER PUMP | Centrifugal type, metal impeller, belt-driven |
| SEA WATER PUMP | Positive displacement, rubber impeller, belt-driven |
| SEA WATER FLOW, AT 1800 RPM (measured before discharging into exhaust elbow.) | 7.2 gpm (27.25 lpm) |
| SYSTEM CAPACITY(Fresh Water) | 8 quarts (7.6 liters) |

***LUBRICATION SYSTEM:***

| | |
|---|---|
| GENERAL | Pressure type by Trichoid pump, gear driven with external pressure relief valve |
| OIL FILTER | Full flow, paper element, spin-on type |
| SUMP CAPACITY | 4.23 quarts (4.0 liters) |
| OPERATING OIL PRESSURE (engine hot) | 40 - 80 psi (2.8 - 5.6 $kg/cm^2$) |
| OIL GRADE | API specification CC or CD |

## SYSTEM SPECIFICATIONS CONTINUED...

### *ELECTRICAL SYSTEM*

| | |
|---|---|
| STARTING BATTERY | 12-Volt, ( - ) negative ground |
| BATTERY CAPACITY | 300-400 CCA |
| DC CHARGING ALTERNATOR | 12-volt DC, 50 Amp |
| REGULATOR | Internal regulator built into alternator |
| STARTING AID | Glow Plug, sheathed type |
| STARTER | 12-volt, 1.6 KW, reduction type, solenoid mounted |
| DC NO-LOAD CURRENT | 90 Amp (max.) at 11.5 Volts |
| DC CRANKING CURRENT | 175 - 200 Amps (engine cold) |

### *AC GENERATOR*

| | |
|---|---|
| GENERAL | Brushless, four-pole, revolving field.<br>Pre-lubricated single-bearing design.<br>Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation) |
| VOLTAGE | 120 or 120/240 Volts - 60 Hertz<br>220 Volts - 50 Hertz<br>Voltage regulation:± 5 % no load to full load<br>Frequency regulation: ± 3 % Hertz (5%) no load to full load |

RATING (Volts AC)

| | | |
|---|---|---|
| 60 HERTZ (1800 rpm)<br>11.0 KW | 120 Volts<br>120/240 Volts | 91.6 Amps<br>91.6/45.8 Amps |
| 50 HERTZ (1500 rpm)<br>8.3 KW | 220 Volts | 37.7 Amps |

| | |
|---|---|
| GENERATOR COOLING AIR REQUIREMENTS, (60 Hertz), at 1800 rpm | 200 - 225 cfm (5.66 - 6.37 cmm) |

**NOTE: Increase air supply 15 % for 50 Hertz operation 1500 rpm.**

## SYSTEM SPECIFICATIONS CONTINUED...

| | |
|---|---|
| General - 3 Phase<br>11.0 KW - 60 Hertz<br>8.3 KW - 50 Hertz | Brushless six pole, revolving field. Sealed lubricated single bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid State voltage regulator with protection circuitry. |
| Voltage - 3 Phase (60 Hertz) | Low voltage WYE 208 volts<br>High voltage WYE 480 volts<br>DELTA 240 volts |
| Voltage - 3 Phase (50 Hertz) | High voltage WYE 380 volts<br>DELTA 220 volts |
| Amperage - 3 Phase (60 Hertz) | Low voltage WYE 38 Amps<br>High voltage WYE 16 Amps<br>DELTA 33 Amps |
| Amperage - 3 Phase (50 Hertz) | High voltage WYE 15 Amps<br>DELTA 27 Amps |

***AC GENERATOR :***

| | |
|---|---|
| ENGINE COMBUSTION AIR REQUIREMENTS (60 Hertz) AT 1800 rpm | 32 cfm (.906 cmm) |
| ENGINE COMPARTMENT COOLING AIR | 100-200 cfm (2.83 - 5.66 cmm) |

***TUNE UP SPECIFICATIONS***

| | |
|---|---|
| INJECTOR PRESSURE | 1707 psi (120 kg/cm$^2$ + 10 kg/cm$^2$ - 0 kg/cm$^2$) |
| ENGINE TIMING | 19° BTDC |

## BTD 12.5 KW MARINE DIESEL GENERATOR SET GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | Diesel, 4-cycle, 4-cylinder, fresh water-cooled<br>Vertical, in-line overhead valve mechanism<br>(23 hp at 1800 rpms maximum) |
| Governor | Mechanical, centrifugal weight type |
| Combustion Chamber | Swirl chamber type |
| Bore & Stroke | 3.07 × 3.07 inches (78 × 78 mm) |
| Pistion Displacement | 91 cubic inches (1.49 liters) |
| Firing Order | 1-3-4-2 |
| Direction of Rotation | Clockwise, when viewed from the front |
| Maximum Torque (at 1800 rpm) | 67 lb-ft (9.26 kg-m) |
| Compression Ratio | 23 : 1 |
| Compression Pressure | 455 psi (32 kg/cm$^2$) at 280 rpm |
| Valve Timing | Intake Opens 20° BTDC<br>Intake Closes 44° ABDC<br><br>Exhaust Opens 44° BBDC<br>Exhaust Closes 20° ATDC |
| Valve Seat Angle | Intake 45°<br>Exhaust 45° |
| Valve Clearance<br>(engine cold) | Intake 0.0098 inches (0.25 mm)<br>Exhaust 0.0098 inches (0.25 mm) |
| Engine Speed | 1800 rpm 60 Hertz<br>1500 rpm 50 Hertz |
| Dimensions | Height: 25.34 inches (643.60mm)<br>Width: 18.17 inches (461.50 mm)<br>Length: 37.25 inches (946.10 mm) |
| Weight | 638 lbs (289.4 kgs) |
| Fuel Consumption | 1.4 gph (5.29 lph) at full rated<br>output (approximate) |
| Inclination | Continuous 15°<br>Temporary 20° (not to exceed 20 min.) |

## SYSTEM SPECIFICATIONS

***FUEL SYSTEM:***

| | |
|---|---|
| GENERAL | Open flow, totally self-bleeding |
| FUEL | No. 2 Diesel oil (cetane rating of 45 or higher) |
| FUEL INJECTION PUMP | Nippon Denso (Bosch M type) |
| FUEL INJECTION TIMING | 19° BTDC ±0.5 (static timing) |
| NOZZLE<br>INJECTORS | Throttle type<br>Pintle type |
| FUEL PUMP<br>FUEL FILTER(on engine) | 12-Volt DC; Electro-Magnetic type<br>Canister type, with replaceable element |
| AIR CLEANER | Metal screen type-cleanable |
| AIR FLOW | 48 cfm (1.2 cmm) |

***COOLING SYSTEM:***

| | |
|---|---|
| GENERAL | Closed fresh water-cooled block, thermostatically controlled with heat exchanger. |
| OPERATING TEMPERATURE | 170° - 190° F (77° - 88° C) |
| FRESH WATER PUMP | Centrifugal type, metal impeller, belt-driven |
| SEA WATER PUMP | Positive displacement, rubber impeller, belt-driven |
| SEA WATER FLOW, AT 1800 RPM (measured before discharging into exhaust elbow.) | 7.2 gpm (27.25 lpm) |
| SYSTEM CAPACITY(Fresh Water) | 8 quarts (7.6 liters) |

***LUBRICATION SYSTEM:***

| | |
|---|---|
| GENERAL | Pressure type by Trichoid pump, gear driven with external pressure relief valve |
| OIL FILTER | Full flow, paper element, spin-on type |
| SUMP CAPACITY | 4.76 quarts (4.5 liters) plus filter/cooler assembly |
| OPERATING OIL PRESSURE (engine hot) | 40 - 80 psi (2.8 - 5.6 $kg/cm^2$) |
| OIL GRADE | API specification CC or CD |

## SYSTEM SPECIFICATIONS CONTINUED...

### *ELECTRICAL SYSTEM*

| | |
|---|---|
| STARTING BATTERY | 12-Volt, ( - ) negative ground |
| BATTERY CAPACITY | 300-400 CCA |
| DC CHARGING ALTERNATOR | 12-volt DC, 50 Amp |
| REGULATOR | Internal regulator built into alternator |
| STARTING AID | Glow Plug, sheathed type |
| STARTER | 12-volt, 1.6 KW, reduction type, solenoid mounted |
| DC NO-LOAD CURRENT | 90 Amp (max.) at 11.5 Volts |
| DC CRANKING CURRENT | 175 - 200 Amps (engine cold) |

### *AC GENERATOR*

| | |
|---|---|
| GENERAL | Brushless, four-pole, revolving field.<br>Pre-lubricated single-bearing design.<br>Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation) |
| VOLTAGE | 120 or 120/240 Volts - 60 Hertz<br>220 Volts - 50 Hertz<br>Voltage regulation:± 5 % no load to full load<br>Frequency regulation: ± 3 % Hertz (5%) no load to full load |

RATING (Volts AC)

| | | |
|---|---|---|
| 60 HERTZ (1800 rpm)<br>12.5 KW | 120 Volts<br>120/240 Volts | 104 Amps<br>104/52 Amps |
| 50 HERTZ (1500 rpm)<br>9.3 KW | 220 Volts | 42.3 Amps |

| | |
|---|---|
| GENERATOR COOLING AIR REQUIREMENTS, (60 Hertz), at 1800 rpm | 200 - 225 cfm (6.37 - 7.08 cmm) |

**NOTE: Increase air supply 15 % for 50 Hertz operation 1500 rpm.**

## SYSTEM SPECIFICATIONS CONTINUED...

| | |
|---|---|
| General - 3 Phase<br>12.5 KW - 60 Hertz<br>9.3 KW - 50 Hertz | Brushless six pole, revolving field. Sealed lubricated single bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid State voltage regulator with protection circuitry. |
| Voltage - 3 Phase (60 Hertz) | Low voltage WYE 208 volts<br>High voltage WYE 480 volts<br>DELTA 240 volts |
| Voltage - 3 Phase (50 Hertz) | High voltage WYE 380 volts<br>DELTA 220 volts |
| Amperage - 3 Phase (60 Hertz) | Low voltage WYE 43 Amps<br>High voltage WYE 18 Amps<br>DELTA 37 Amps |
| Amperage - 3 Phase (50 Hertz) | High voltage WYE 17 Amps<br>DELTA 30 Amps |

***AC GENERATOR :***

| | |
|---|---|
| ENGINE COMBUSTION AIR REQUIREMENTS (60 Hertz) AT 1800 rpm | 32 cfm (.906 cmm) |
| ENGINE COMPARTMENT COOLING AIR | 100-200 cfm (2.83 - 5.66 cmm) |

***TUNE UP SPECIFICATIONS***

| | |
|---|---|
| INJECTOR PRESSURE | 1707 psi (120 $kg/cm^2$ + 10 $kg/cm^2$ - 0 $kg/cm^2$) |
| ENGINE TIMING | 19° BTDC |

## BTDA 12.5 KW MARINE DIESEL GENERATOR SET GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | Diesel, 4-cycle, 4-cylinder, fresh water-cooled<br>Vertical, in-line overhead valve mechanism<br>(23 hp at 1800 rpms maximum) |
| Governor | Mechanical, centrifugal weight type |
| Combustion Chamber | Swirl chamber type |
| Bore & Stroke | 3.07 × 3.07 inches (78 × 78 mm) |
| Pistion Displacement | 91 cubic inches (1.49 liters) |
| Firing Order | 1-3-4-2 |
| Direction of Rotation | Clockwise, when viewed from the front |
| Maximum Torque (at 1800 rpm) | 67 lb-ft (9.26 kg-m) |
| Compression Ratio | 23 : 1 |
| Compression Pressure | 455 psi (32 kg/cm$^2$) at 280 rpm |
| Valve Timing | Intake Opens 20° BTDC<br>Intake Closes 44° ABDC<br><br>Exhaust Opens 44° BBDC<br>Exhaust Closes 20° ATDC |
| Valve Seat Angle | Intake 45°<br>Exhaust 45° |
| Valve Clearance<br>(engine cold) | Intake 0.0098 inches (0.25 mm)<br>Exhaust 0.0098 inches (0.25 mm) |
| Engine Speed | 1800 rpm 60 Hertz<br>1500 rpm 50 Hertz |
| Dimensions | Height: 25.34 inches (643.60mm)<br>Width: 18.17 inches (461.50 mm)<br>Length: 37.25 inches (946.10 mm) |
| Weight | 638 lbs (289.4 kgs) |
| Fuel Consumption | 1.1 gph (4.2 lph) at full rated<br>output (approximate) |
| Inclination | Continuous 15°<br>Temporary 20° (not to exceed 20 min.) |

## SYSTEM SPECIFICATIONS

***FUEL SYSTEM:***

| | |
|---|---|
| GENERAL | Open flow, totally self-bleeding |
| FUEL | No. 2 Diesel oil (cetane rating of 45 or higher) |
| FUEL INJECTION PUMP | Nippon Denso (Bosch M type) |
| FUEL INJECTION TIMING | 19° BTDC ±0.5 (static timing) |
| NOZZLE<br>INJECTORS | Throttle type<br>Pintle type |
| FUEL PUMP<br>FUEL FILTER(on engine) | 12-Volt DC; Electro-Magnetic type<br>Canister type, with replaceable element |
| AIR CLEANER | Metal screen type-cleanable |
| AIR FLOW | 48 cfm (1.2 cmm) |

***COOLING SYSTEM:***

| | |
|---|---|
| GENERAL | Closed fresh water-cooled block, thermostatically controlled with heat exchanger. |
| OPERATING TEMPERATURE | 170° - 190° F (77° - 88° C) |
| FRESH WATER PUMP | Centrifugal type, metal impeller, belt-driven |
| SEA WATER PUMP | Positive displacement, rubber impeller, belt-driven |
| SEA WATER FLOW, AT 1800 RPM (measured before discharging into exhaust elbow.) | 7.2 gpm (27.25 lpm) |
| SYSTEM CAPACITY(Fresh Water) | 8 quarts (7.6 liters) |

***LUBRICATION SYSTEM:***

| | |
|---|---|
| GENERAL | Pressure type by Trichoid pump, gear driven with external pressure relief valve |
| OIL FILTER | Full flow, paper element, spin-on type |
| SUMP CAPACITY | 4.76 quarts (4.5 liters) plus filter/cooler assembly |
| OPERATING OIL PRESSURE (engine hot) | 40 - 80 psi (2.8 - 5.6 kg/cm$^2$) |
| OIL GRADE | API specification CC or CD |

## SYSTEM SPECIFICATIONS CONTINUED...

### *ELECTRICAL SYSTEM*

| | |
|---|---|
| STARTING BATTERY | 12-Volt, ( - ) negative ground |
| BATTERY CAPACITY | 300-400 CCA |
| DC CHARGING ALTERNATOR | 12-volt DC, 50 Amp |
| REGULATOR | Internal regulator built into alternator |
| STARTING AID | Glow Plug, sheathed type |
| STARTER | 12-volt, 1.6 KW, reduction type, solenoid mounted |
| DC NO-LOAD CURRENT | 90 Amp (max.) at 11.5 Volts |
| DC CRANKING CURRENT | 175 - 200 Amps (engine cold) |

### *AC GENERATOR*

| | |
|---|---|
| GENERAL | Brushless, four-pole, revolving field.<br>Pre-lubricated single-bearing design.<br>Reconnectable, single-phase transformer regulation<br>(optional solid-state voltage regulation) |
| VOLTAGE | 120 or 120/240 Volts - 60 Hertz<br>220 Volts - 50 Hertz<br>Voltage regulation:± 5 % no load to full load<br>Frequency regulation: ± 3 % Hertz (5%) no load to full load |

RATING (Volts AC)

| | | |
|---|---|---|
| 60 HERTZ (1800 rpm)<br>12.5 KW | 120 Volts<br>120/240 Volts | 104 Amps<br>104/52 Amps |
| 50 HERTZ (1500 rpm)<br>9.3 KW | 220 Volts | 42.3 Amps |

| | |
|---|---|
| GENERATOR COOLING AIR REQUIREMENTS, (60 Hertz), at 1800 rpm | 200 - 225 cfm (6.37 - 7.08 cmm) |

**NOTE: Increase air supply 15 % for 50 Hertz operation 1500 rpm.**

## SYSTEM SPECIFICATIONS CONTINUED...

| | |
|---|---|
| General - 3 Phase<br>12.5 A KW - 60 Hertz<br>9.3 A KW - 50 Hertz | Brushless six pole, revolving field. Sealed lubricated single bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid State voltage regulator with protection circuitry. |
| Voltage - 3 Phase (60 Hertz) | Low voltage WYE 208 volts<br>High voltage WYE 480 volts<br>DELTA 240 volts |
| Voltage - 3 Phase (50 Hertz) | High voltage WYE 380 volts<br>DELTA 220 volts |
| Amperage - 3 Phase (60 Hertz) | Low voltage WYE 43 Amps<br>High voltage WYE 18 Amps<br>DELTA 37 Amps |
| Amperage - 3 Phase (50 Hertz) | High voltage WYE 17 Amps<br>DELTA 30 Amps |

***AC GENERATOR :***

| | |
|---|---|
| ENGINE COMBUSTION AIR REQUIREMENTS (60 Hertz) AT 1800 rpm | 32 cfm (.906 cmm) |
| ENGINE COMPARTMENT COOLING AIR | 100-200 cfm (2.83 - 5.66 cmm) |

***TUNE UP SPECIFICATIONS***

| | |
|---|---|
| INJECTOR PRESSURE | 1707 psi (120 kg/cm$^2$ + 10 kg/cm$^2$ - 0 kg/cm$^2$) |
| ENGINE TIMING | 19° BTDC |

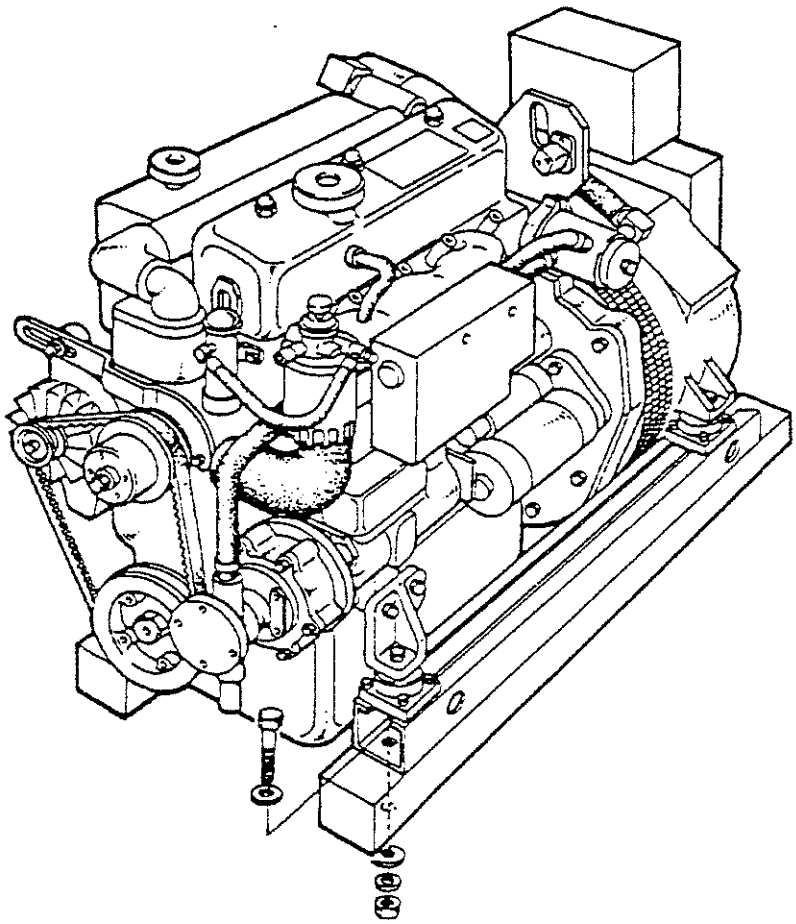
## INSTALLATION CHECKS

### General

Because the crafts in which Westerbeke engines and generators are installed vary in design, installation procedures will vary according to your craft's specific design. It is not the intent of this section to advise boatyards or installers on procedures already well-developed and well-understood. However, it is important that the owner/operator realize there are details of the installation which require periodic checks to ensure the best operating conditions for the equipment and safe operating conditions for the personnel on board.

Proper location and installation of the generator set in the vessel are of prime importance.

Factors in the installation that must be considered are ventilation, so as to cool the generator and to provide air for engine combustion; exhaust system, to properly discharge raw cooling water, to quiet the exhaust and to expel the exhaust gas; cooling water supply; fuel supply; and electrical connections.



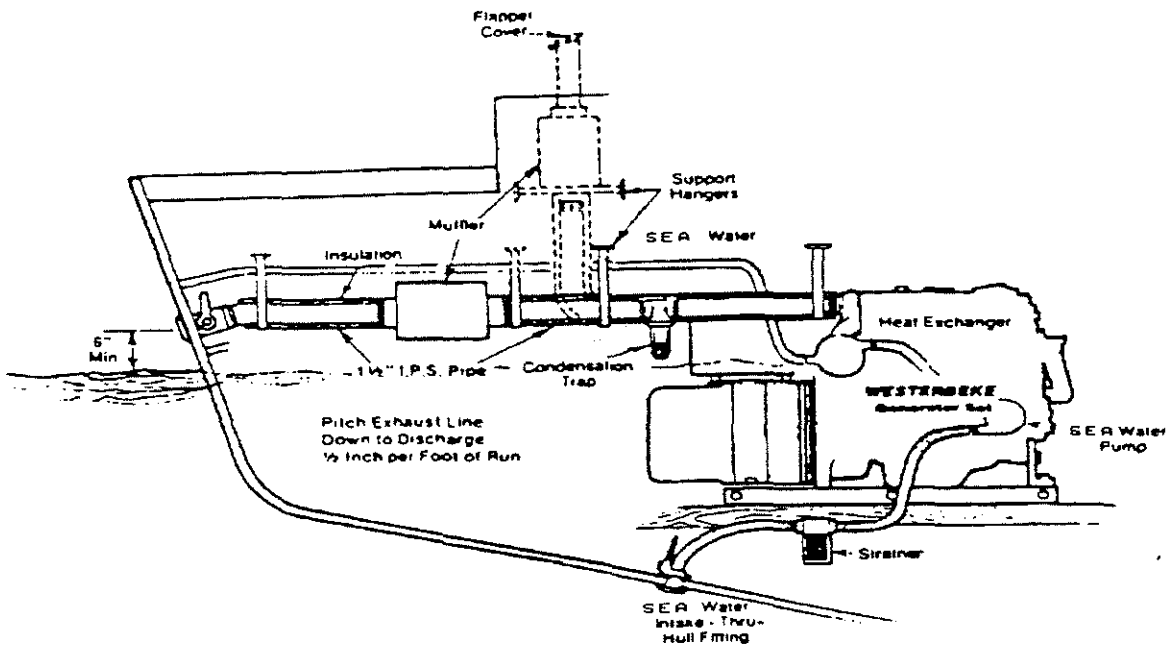
Factors in the location that must be considered are proper support and access for servicing and repairs. There are four 1/2-inch bolt holes in each generator mounting rail to properly secure the generator to its mounting platform.

## Location

The location should be such that it is dry, above low-lying vapor areas, and away from being splashed by bile water or water from above. It should be properly ventilated and accessible for minor servicing and repairs. Access for major repairs should be given consideration as well. The location must be properly ventilated to provide the fresh cooling air for the generator end and for engine combustion. Hot generator discharge air must be removed from the generator area. The platform on which the generator and its mounting rails are located should be strong enough to support the generator unit during all angles of vessel operation.

## Exhaust System

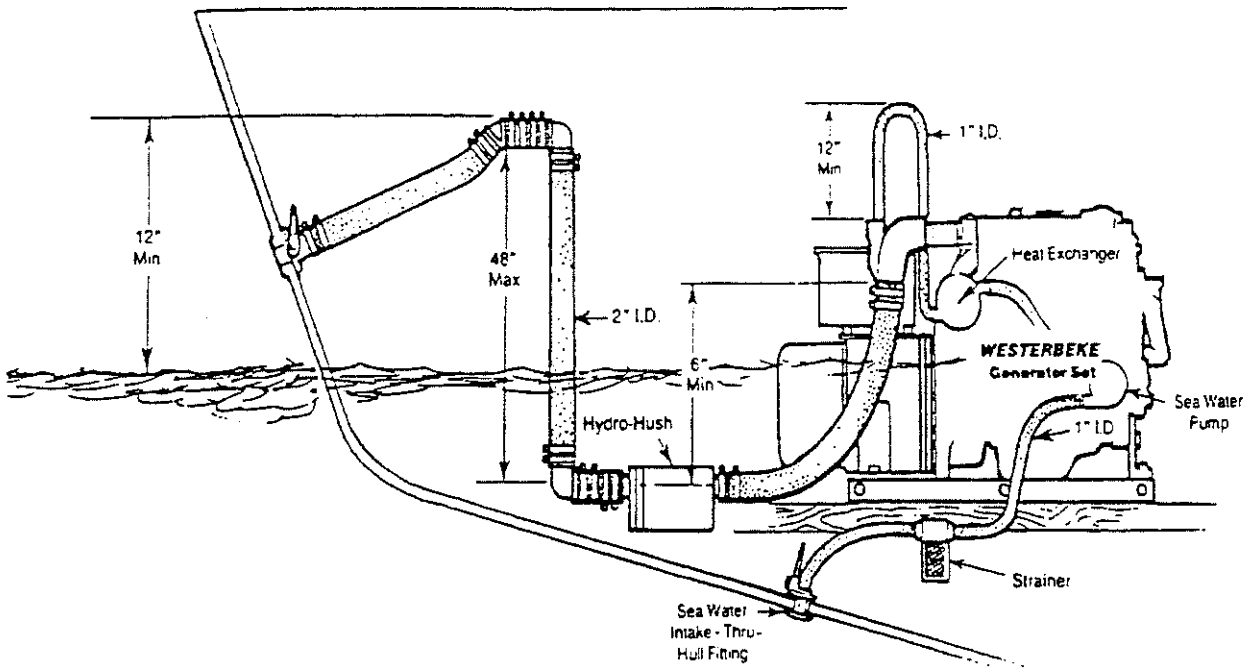
The exhaust system provides an outlet line to vent engine exhaust gases out of and away from the vessel. The system also discharges sea water which has passed through the engine's sea water circuit by mixing it with hot exhaust gases. This mixing helps to cool the exhaust gases and exhaust elbows and pipe. The exhaust system and the sea water supply to the exhaust must be configured to prevent the siphoning of sea water into the exhaust through the sea water cooling circuit and to prevent the entry of sea water into the exhaust through the circuit's thru-hull discharge port. If not prevented, sea water entering through the discharge port can fill the exhaust system's muffler and enter the engine' s cylinders. This will prevent proper starting and possibly cause damage to internal engine components.




Dry Stack Exhaust

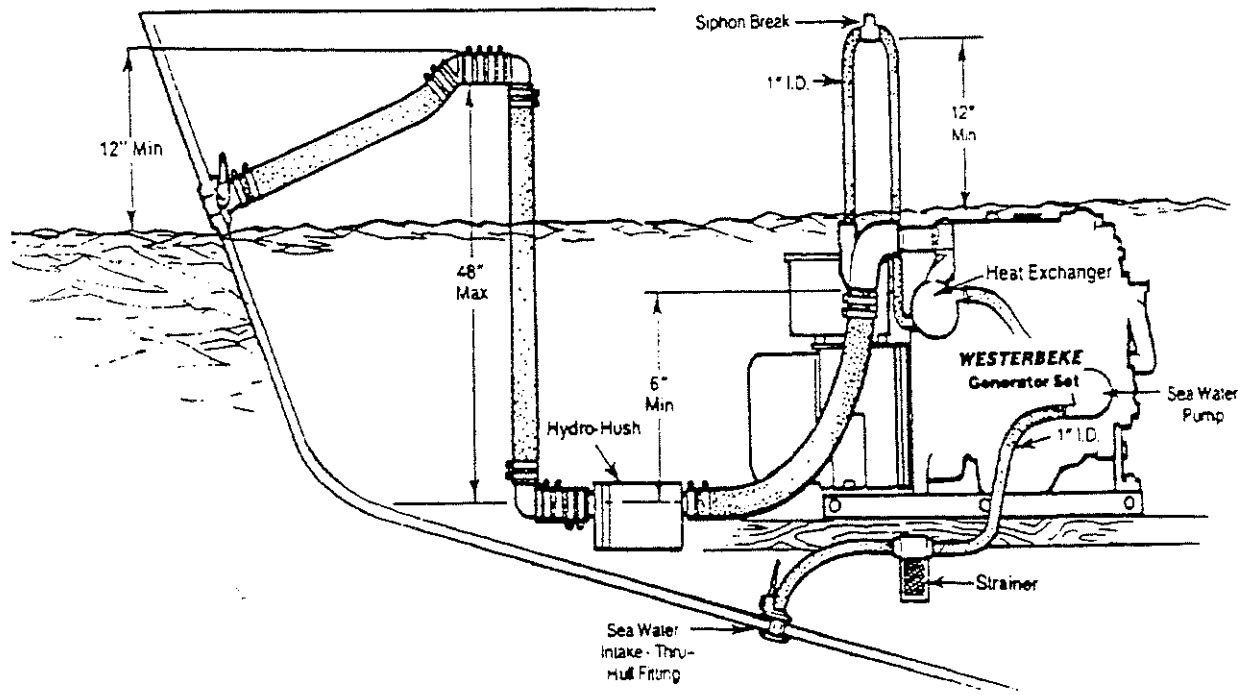
The sea water supply hose to the exhaust system's water injection elbow should be routed (looped) at least 12 inches above the vessel's water line. An anti-siphon break should be installed at the top of this loop when the generator set is installed at or below the water line. The top of the loop should be placed high enough above the vessel's water line so as to remain above the water line when the vessel is underway, no matter what the angle of heel or roll may be.

The sea water supply thru-hull seacock fittings must be of the flush-hull type. High-speed scoop type fittings should not be used, as they tend to encourage siphoning.




Generator Above Water Line

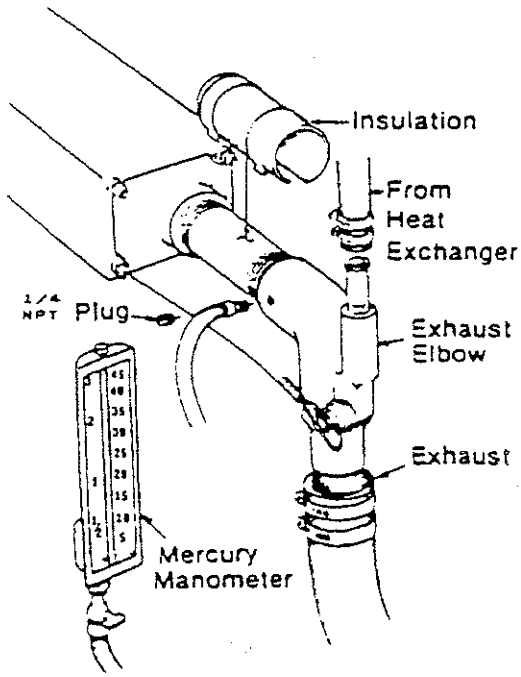
The exhaust discharge from the water lift muffler should be routed well above the water line then downward to the thru-hull discharge. This routing will prevent sea water from entering if the thru-hull discharge fitting becomes submerged when the vessel heels or rolls while underway, or is subjected to following sea conditions. Refer to the figures for recommended exhaust system installations.




Generator Below Water Line

**Exhaust Back-Pressure**

Exhaust back-pressure should be checked prior to putting a generator into service. (Refer to illustration.) Excessive back-pressure will affect the engine's performance and the generator's power output.




To measure the engine's back-pressure, either a mercury manometer or a water column must be acquired. A boatyard or marine mechanic should have a clear plastic tube and taping one end to a yardstick and fitting the other end with a 1/4 inch NPT (National Pipe Tap) fitting. Fill the tube half-full with water. If your generator set does not have a tapped hole in its exhaust manifold, one must be drilled and tapped for a 1/4-inch NPT fitting.

Measure back-pressure at the exhaust elbow when the generator is under a full load. Back-pressure, as measured by a manometer or water column, should not be over the following specifications:

3 inches of mercury (0.104 kg/cm$^2$)
39 inches of water in the column (.099 kg/cm$^2$ at 4° C)
22 ounces of psi
1 1/2 psi

NOTE: Other pressure gauges may be available to test for exhaust back-pressure.

**Oil Drain**

An oil sump drain hose is installed on the engine with the discharge end secured by a bracket at the front of the engine. Oil may be drained from this hose by removing the cap and the discharge end of the hose from the support bracket and lowering the hose into a container. The hose cap fitting is 1/4 inch-NPT (National Pipe Tap) and can be extended, or have a pump added, for easier removal of the old oil, if desired.

**Cooling System**

The generator's engine is fresh water cooled by an engine-mounted heat exchanger. Sea water is used as the heat exchange's cooling medium. Sea water is pumped into the exchanger by a sea water pump and is then injected into the exhaust discharge, carrying with it the heat removed from the engine's fresh water cooling system.

Sea water should be supplied to the sea water pump through a flush-type hull fitting using a wire-reinforced hose between the thru-hull fitting and the sea water pump. This sea water should be directed through a visual-type sea water strainer and then delivered to the pump. Hoses routed from the thru-hull fitting to the strainer and to the sea water pump should be wire-reinforced to prevent the hose from collapsing during the generator's operation (suction from the pump may collapse a non-reinforced hose.) Sea water strainers should be mounted at or below the water line to make sure the sea water line remains primed.

*CAUTION*

Do not use a scoop-type thru-hull fitting as a means of supplying sea water to the generator. Water pressure against this type fitting, while the vessel is under way, can push sea water past the sea water pump's impeller into the generator's exhaust system, filling it and the engine as well. Flush-type, clear, thru-hull fittings are recommended and should be located on the hull so as to be below the waterline during all angles of boat operation.

The use of common-type street elbows is not recommended for plumbing the sea water circuit. These generally have very restrictive inside diameters. Machined fittings are preferred.

**Automatic Shutdown**

High Exhaust Temperature Shutdown Switch (normally closed)

An exhaust temperature switch is located on the exhaust elbow. This switch will open and shut the fuel solenoid OFF (which turns OFF the engine) should the switch's sensor indicate an excessive exhaust temperature (an inadequate supply of sea water coolant causes high exhaust temperatures). This switch opens at 260° - 270° F (127 - 132° C). This switch resets at 195° F (107° C).

Low Oil Pressure Shutdown Switch (normally open)

A low oil pressure shutdown switch is located off the engine's oil gallery. This switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 10-15 psi, the switch will open shutting OFF the fuel solenoid (which turns OFF the engine).

*WARNING*

Although diesel engine exhaust gases are not as toxic as exhaust fumes from gasoline engines, carbon monoxide is present in diesel exhaust fumes. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation or poisoning are listed below.

- Dizziness
- Intense headache
- Weakness and sleepiness
- Vomiting
- Muscular twitching
- Throbbing in temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide poisoning is a daily inspection of the complete exhaust system. Check for leaks around manifolds, gaskets, and welds. Make sure exhaust lines are not heating surrounding areas excessively. If excessive heat is present, correct the situation immediately. If you notice a change in the sound or appearance of the exhaust system, shut down the unit immediately and have the system inspected and repaired at once by a qualified mechanic.

Make sure there are no unnecessary objects suspended from any portion of the exhaust lines. Excessive weight could cause deflection or distortion of the lines, resulting in damage leaks. Inspect insulated portions of the exhaust system to ensure there is no deterioration of the insulation.

**Intake System**

Make sure the intake system (sea water cooling system) is in proper order. Check that the hull inlet, seacock and strainer are unobstructed. Seacocks and strainers should be at least one size greater than the inlet thread of sea water pump. The strainer should be of the type that may be withdrawn for cleaning while the vessel is at sea and should be mounted below the water line to ensure self-priming. Inspect the sea water lines to ensure there are no collapsed sections, which would restrict water flow. Make sure there are no air leaks at any of the connections.

**Fuel System**

The generator must have its own fuel supply; in other words, it must have its own pickup tube and primary filter/water separator. DO NOT tee off another engine's fuel supply. The fuel system should be installed in such a manner as to allow the engine-mounted fuel lift pump to maintain a positive inlet pressure to the injection pump under all operating conditions. The minimum size of the fuel supply line and fuel tank and the fuel lift pump. A secondary fuel filter has been installed on the engine between the fuel lift pump and the injection pump; this filter has a replaceable filter element. Make sure that the fuel supply and return lines are securely anchored to prevent chafing and that all fittings are sufficiently tightened to prevent leaking. Also make sure your fuel system has a positive shut-off valve; know its location and how it operates.

**NOTE**: Ensure that the fuel pickup tubes in the fuel tank supplying the generator are clear of any gauze or screen type strainers. These can easily clog and cause fuel starvation to the generator's engine.

**DO NOT** use mechanical type check valves in lieu of a manual shut off valve.

**Electrical System**

The electrical system should be checked to ensure that all wiring harnesses are properly tied down with clamps or plastic ties and that all wiring harnesses are spaced at intervals close enough to prevent chafing from vibration. Check to ensure that all engine harness connections are tight and that they are made to the appropriate terminals.

**Generator (AC Output)**

Make sure that the AC output connections within the generator's districation box are tight and in accordance with the specific AC Load Connections diagram found later in this manual. (See the "BT GENERATOR" section of this manaul.)

***WARNING***

DO NOT smoke or allow an open flame near batteries. Lead acid batteries emit hydrogen, a highly-explosive gas.

**Batteries**

Make sure the positive (+) battery connection is connected to the battery connection of the starting solenoid. The negative ( - ) battery connection should be connected to the system ground (engine block).

***WARNING***

When servicing the battery or checking electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Battery acid may splash on the skin or into the eyes inadvertently when removing electrolyte caps.

Check the battery's electrolyte level ans specific gravity to ensure maximum engine starting efficiency. Make sure the battery's terminals are clean and tight.

**Ventilation**

The ventilation requirements of the generator sets include the following: combustion air is required for the engine cylinders; cooling air is required for the generator end; and ventilating air is required to clear the bilges below the generator, as well as the compartment in which the generator is located, of potentially toxic and flammable diesel fumes. Refer to the "SYSTEM SPECIFICATIONS" section of this manual for the airflow requirements of the generator sets.

## OPERATION

This section of the manual provides the operator with preparation, initial starting, break-in, starting (cold or warm), and stopping procedures. Follow the procedures as presented, for the conditions indicated, and your Westerbeke generator set will give you reliable performance and long service life.

### Preparation for Starting

Take the steps described below in starting your engine for the first time or after a prolonged shutdown or lay-up.

Fill your engine with oil up to or near the upper limit on the dipstick (the installation angle may have an effect on the dipstick reading). Select a readily available lubricating oil with an API specification of CC or CD and an SAE number suitable for the temperature in your operating area. For the quantity of oil needed in your generator's engine, refer to the "SYSTEM SPECIFICATIONS" section of this manual, located on pages 13 through 33.

Each unit is supplied with a coolant recovery kit (part #24977) as standard equipment, to which the following applies:

a. Remove the pressure cap from the engine's exhaust manifold and slowly fill the engine's cooling system with a mixture of water and antifreeze suitable for your temperature zone. (See the "COOLING SYSTEM" section of this manual.)

b. Make sure the plastic recovery tank is properly mounted near the unit (with the bracket provided) in a location where it can be monitored and filled easily. The recovery tank should be mounted at manifold level or above.

c. Coolant should be added to the plastic recovery tank after the engine has been filled and started. After its operating temperature has been reached, ensure that all air is expelled out of the engine's cooling system and manifold. With the manifold filled to the filler neck, install the pressure cap. Add coolant mixture to the recovery tank to the half-full mark. Check recovery tank daily and add coolant as needed. Very little coolant should be lost from this closed type of cooling system. Periodically check coolant level in exhaust manifold; this should always be full to the filler cap neck.

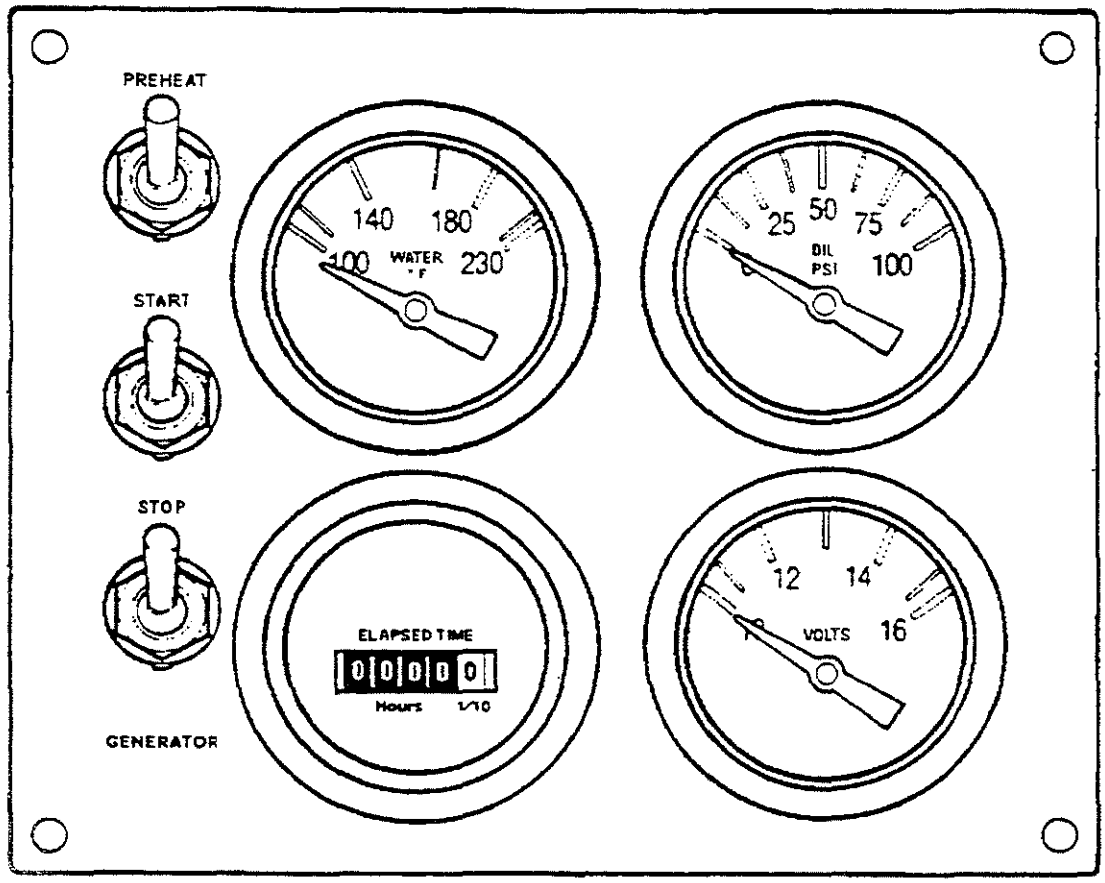
Fill the fuel tank with a good grade of No. 2 diesel fuel and prime the fuel system up to the engine. The engine's own fuel system is totally self-bleeding. Depress the PREHEAT switch for 15 to 30 seconds and monitor the return fuel flow. When the returning fuel is free of air, the engine's fuel system is bled and the engine is ready to start.

NOTE: When the PREHEAT switch is depressed, the glow plugs in the cylinder head are energized; use the PREHEAT switch intermittently to prevent overheating the glow plugs.

Activating the PREHEAT switch energizes the fuel run solenoid, drawing the throttle arm into the preset run position. Ensure that the arm moves rapidly and smoothly.

Ensure that the Installation Checks have been made in accordance with those specified in the "INSTALLATION CHECKS" section of this manual (refer to page 35) and that there is no AC load on the generator prior to starting the engine.

**Starting Procedure**



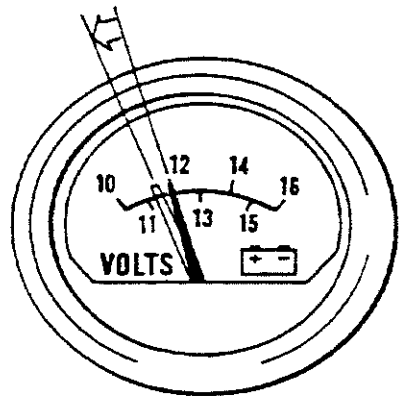

NOTE: When the generator is stopped after use, the water temperature and oil pressure gauges may stay at their running readings.

When the generator is next used, depressing the PREHEAT switch will cause the water temperature and oil pressure gauge indicators to return to zero (deflect to the left of the gauge). The DC voltmeter will register system voltage. The electron on-engine fuel pump, glow plugs, and fuel run solenoid are also energized.

Depress and hold the PREHEAT switch. Preheat according to the following chart:

| *Atmospheric Temperature* | *Preheating Time* |
|---|---|
| *+41°F (+5°C) or higher* | *Approx. 10 seconds* |
| *+41°F (+5°C) to +23°F (-5°C)* | *Approx. 20 seconds* |
| *+23°F (-5°C) or lower* | *Approx. 30 seconds* |
| *Limit of continuous use* | *1 minute* |

Proper glow plug function is indicated by a voltmeter drop when the PREHEAT switch is depressed. This drop will be slight but discernible. If no voltage drop is noted, it may indicate defective glow plugs or a faulty preheat circuit (check for loose connections).




Proper Glow Plug Indication

While holding the PREHEAT switch depressed, depress the START switch. The starter motor will run, thereby cranking the engine. As soon as the engine runs, release the START switch, but continue holding the PREHEAT switch depressed for 2 or 3 seconds. Release the PREHEAT switch when the oil pressure reaches approximately 20 psi. This bypasses the Low Oil Pressure shutdown until the engine's oil pressure rises to its normal running pressure. Now release the PREHEAT switch.

Should the engine not start when the START switch is depressed for 10 to 20 seconds, release both switches and wait 30 seconds; repeat the procedure above. Never run the starter for more than 30 seconds.

*CAUTION*

**Prolonged cranking intervals without the engine starting can result in filling the engine-mounted exhaust system with sea water coolant. This may happen because the sea water pump is pumping sea water through the sea water cooling system during cranking. This sea water can enter the engine's cylinders by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by closing the sea water supply through-hull shut-off, drain the exhaust muffler, and correct the cause for the excessive engine cranking needed to obtain a start. Engine damage resulting from this type of sea water entry is not a warrantable issue; the owner/operator should keep this in mind.**

Once the engine starts, check instruments for proper oil pressure and battery charging voltage. Never attempt to engage the starter while the engine is running. Apply a light load to the generator and allow the engine's operating temperature is reached (170 - 190° F) and when a load is applied to the generator.

**Stopping Procedure**

Remove the AC electrical load from the generator and allow the generator to run for 3 - 5 minutes to stabilize its operating temperatures. Depress the STOP switch and hold it until the generator is completely stopped. Now release the STOP switch.

**Break-In Precautions**

Because the generator set operates at 1800 rpm to produce 60 Hertz, or at 1500 rpm to produce 50 Hertz, control of the generator's engine break-in is governed by the current drawn from the generator.

**Do Not** attempt to break-in your generator set by running it without a load.

Upon starting the generator set, check for proper operation and then encourage a fast warm-up. For the first 10 hours of the generator's operation, run the generator set between 20 and 60 percent of full load.

After the first 10 hours of the generator's operation, the load may be increased to the rated full-load output. Periodically vary the load.

Be aware of motor starting loads and the high current draw required for starting motors (see page 69 for an "Amps for Starting" chart).

**Starting Under Normal Conditions**

Follow the procedure below for routine starting of the generator:

Check the engine's lubricating oil level prior to each day's use. Add oil as needed and maintain the oil level at the high mark on the dipstick.

Check the coolant level in the plastic recovery tank.

> NOTE: Excessive loss of coolant from the plastic recovery tank indicates a cooling system leak. Check the entire cooling system; pressurize the system to locate the leak. In cases of excessive coolant loss, the system must be refilled as outlined under the "Preparation for Starting" section of this manual.

Visually examine the unit; look for any abnormalities and correct them as needed.

Check to ensure that there is sufficient fuel in the tank and examine the filter/separator bowls for contaminants. Clean and drain the bowls as needed.

Start the generator following the procedure given under "Starting Procedure," and allow the engine's operating temperature to reach 140 - 150° F (60 - 66° C) before placing the generator under a heavy load.

**Starting Under Cold Conditions**

Under extremely cold temperatures, the following conditions can occur. Follow the instructions listed below when operating your generator set in cold weather.

LUBRICATING OIL TURNS VISCOUS - Make certain that the lubricating oil used conforms with the ratings for the prevailing atmospheric temperature. Refer to the "LUBRICATION SYSTEM" section of this manual, page 46, for an atmospherical/oil viscosity specification table.

VOLTAGE ACROSS BATTERY TERMINALS DROPS - Make certain that the battery is fully charged to minimize voltage drop across the battery terminals.

THE TEMPERATURE OF THE INTAKE AIR IS LOW AND THE COMPRESSION TEMPERATURE DOES NOT RISE ENOUGH -Allow the glow plugs to operate sufficiently to aid in starting during the preheat period whenever the temperature of the intake air is low and when the compression temperature does not rise enough. Refer to the preheat chart found in the "Starting Procedure" section of this manual, page 30.

## FUEL SYSTEM

### Diesel Fuel

Use No. 2 diesel fuel with a cetane rating of 45 or higher. **Never** use kerosene or home heating oil since these fuels do not have the same lubricating properties as No. 2 diesel fuel.

In cold weather particularly, water vapor is produced by condensation when air is present in the fuel tank. Keep fuel tank(s) full and completely free of dirt and water.

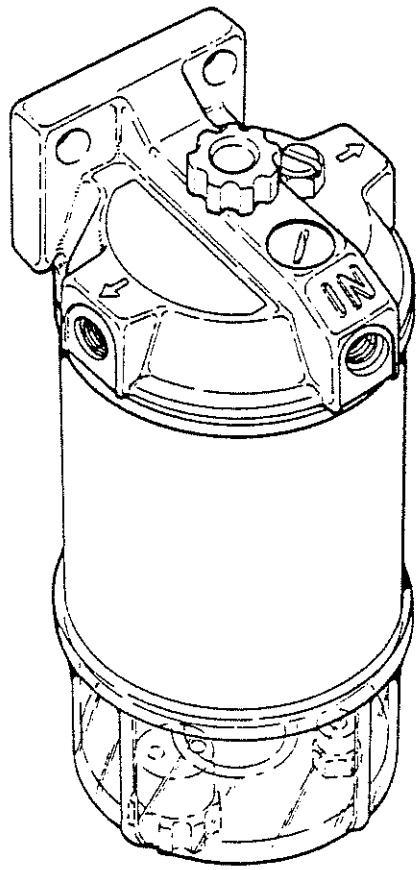
### Fuel Filter/Water Separators

A primary fuel filter of the water separating type *must* be installed between the fuel tank and the engine. This is to remove water and other contaminants from the fuel before they can be carried to the fuel system on the engine.

Most installers include with the generator installation package a type of filter/water separator for they are aware of the problems contaminants in the fuel can cause - all of which are not warrantable through Westerbeke.

A typical fuel filter/water separator is illustrated at the right. This is the Raycor Model 220 F. Keep in mind that if a water separator type filter is not installed between the fuel supply tank and engine-mounted fuel system, any water in the fuel will affect the fuel pump, engine filter, and injection equipment. The owner/operator is responsible for making certain the fuel reaching the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper filtration/separation system.

In addition, any gasoline in the fuel system will damage the engine's fuel injection pump assembly and injectors as gasoline does not have the same lubricating qualities as diesel fuel.



### Priming the Fuel System (Self-Bleeding)

The Westerbeke self-bleeding fuel system is semiautomatic in operation. The self-bleeding feature of the fuel system allows for easy servicing of the fuel filters. Simply remove and replace the filter element (take care in catching any fuel that may drain out of the fuel filtering assembly) as described in the "Replacing the Fuel Filter Element" section. Energize the PREHEAT switch and allow the electric fuel pump to operate for 20 to 30 seconds to prime and bleed air from the system. (No fittings should be opened.) Then proceed to start the engine as you normally would. If the engine does not start, stop and wait a few moments, and then repeat the bleed procedure as indicated above. When the PREHEAT switch is depressed, the preheat elements (the glow plugs) are energized, so take care not to over heat them.

*CAUTION*

**Prolonged cranking intervals without the engine starting can result in filling the engine-mounted exhaust system with sea water coolant. This may happen because the sea water pump is pumping sea water through the sea water cooling system during cranking. This sea water can enter the engine's cylinders by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by closing the sea water supply through-hull shut-off, drain the exhaust muffler, and correct the cause for the excessive engine cranking needed to obtain a start. Engine damage resulting from this type of sea water entry is not a warrantable issue; the owner/operator should keep this in mind.**

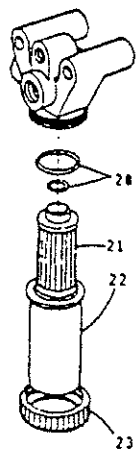
**Replacing the Fuel Filter Element**

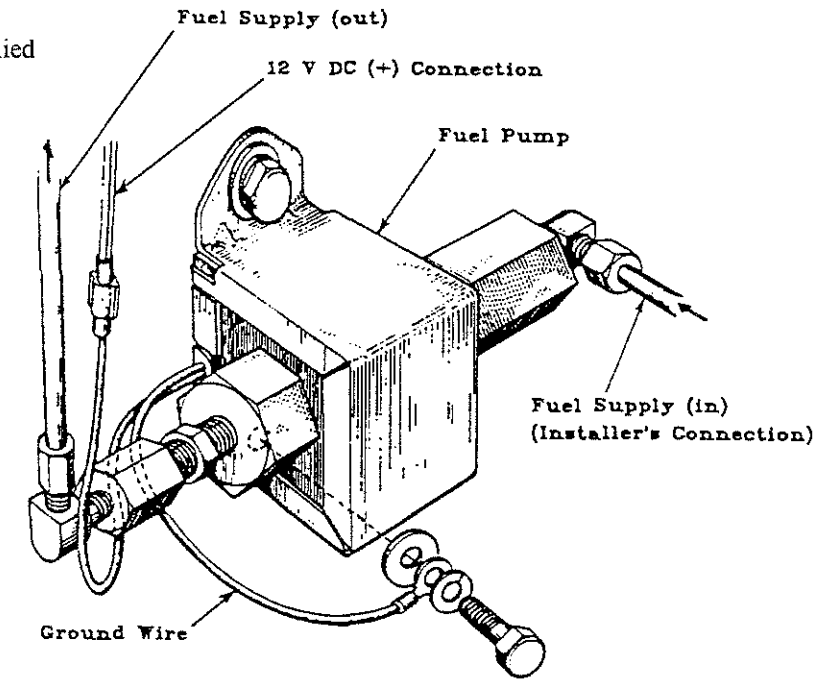
While it is unlikely that the operator will be forced to service the system at sea, the possibility does exist. Therefore, it is recommended that banjo washers, injectors seat washers, a fuel system hardware kit, fuel filter and gasket be carried on board at all times. Select the parts for your engine from the Parts List and purchase spares from your local Westerbeke Dealer or Distributor. For example, fuel filter kit #30200 includes replacement elements with gaskets (items #21 and 20). If a leak should develop at a fuel banjo or sealing washer location that cannot be remedied by a slight tightening, the sealing washers and banjo bolts contained in the fuel system hardware kit for your particular model will come in handy to remedy these leaks.

After the first 50 hours operation, loosen retainer ring #23 and discard filter element #21. Clean bowl #22 and install a new filter using a new #20 gasket. **Be careful to catch any fuel that may spill from within these fuel filter assemblies.**

After the first 50-hour change, the change period may be increased to 200 hours or once per season.

The fuel pump has no filter element within it. The only maintenance it requires is to ensure the connections to itm, both fuel and electrical, are secure and tight and that fuel supplied to this pump is free of impurities.

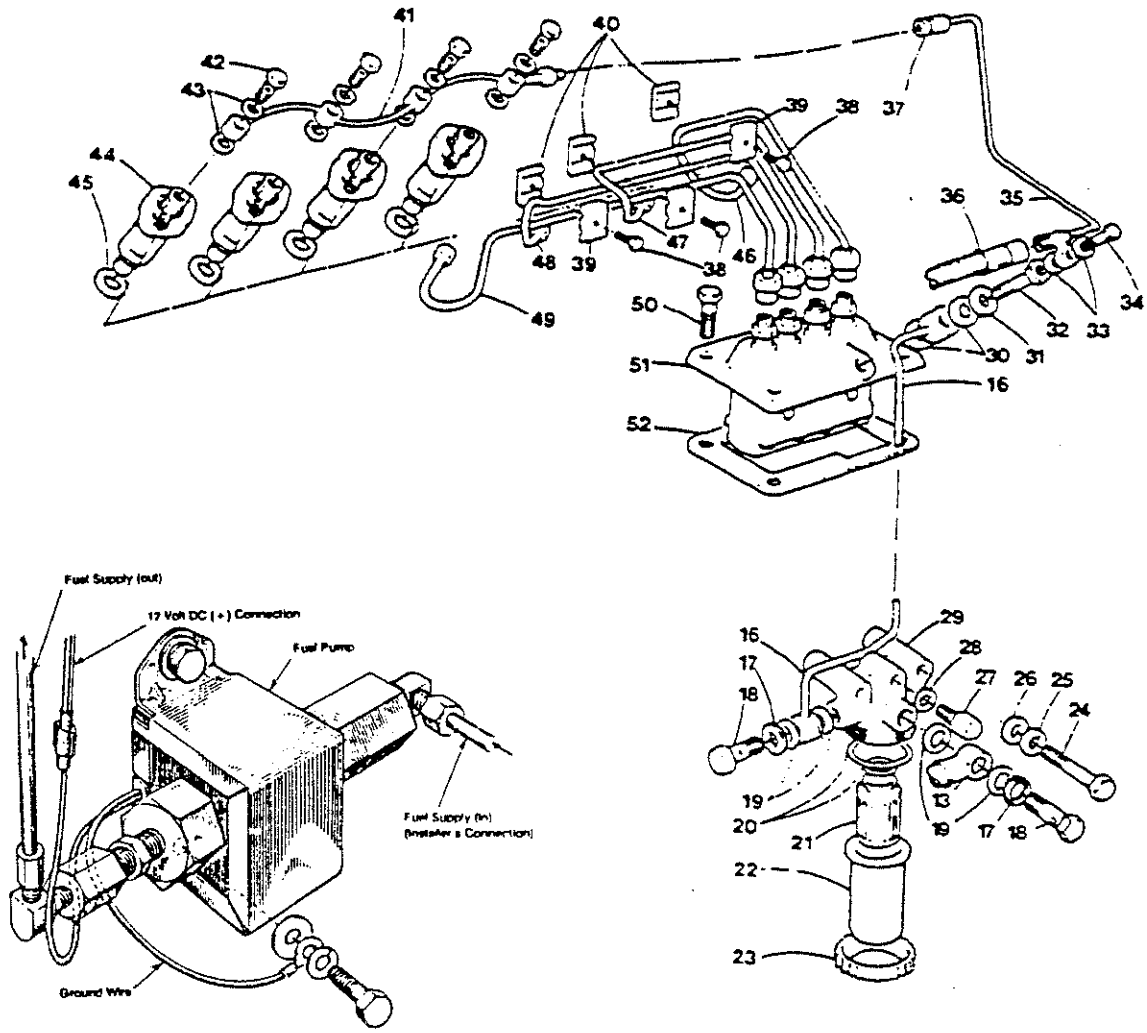


**Fuel Injection Pump**

The fuel injection pump is one of the most important components of the diesel engine and therefore calls for the utmost caution in handling. Furthermore, the fuel injection pump has been thoroughly bench-tested and should not be tampered with.

Running speed and timing adjustment are the only adjustments the servicing dealer can perform on the injection pump. Other types of adjustments or repairs must be performed by a qualified injection service shop.




Typical Fuel System

To obtain long and satisfactory service from the injection pump, always use fuel which is free from impurities and maintain a good filtration and water separation system between the fuel tank and generator engine. Service this system regularly: the injection pump is saves may be your own.

### Engine 12-Volt DC Control Circuit

The engine that drives the generator end has a 12-Volt DC electrical control circuit, as shown on the wiring diagrams which are illustrated on the following pages. Refer to these diagrams when troubleshooting or servicing electrical components on the engine.

*CAUTION*

To avoid damage to the battery's charging circuit, never shut off the engine's battery switch while the engine is running.

However, shut off the engine's battery switch to avoid electrical shorts when working on the engine's electrical circuit.

### Battery Specification

The minimum recommended capacity of the battery used in the engine's 12-Volt DC control circuit is 90 - 125 Ampere-Hours (minimum) for the generator sets covered by this manual.

*CAUTION*

When quick-charging the battery with an external charger, be sure to disconnect the battery cables from the battery. Leaving the charging circuit connected while quick-charging will damage the alternator's diodes.

### Alternator

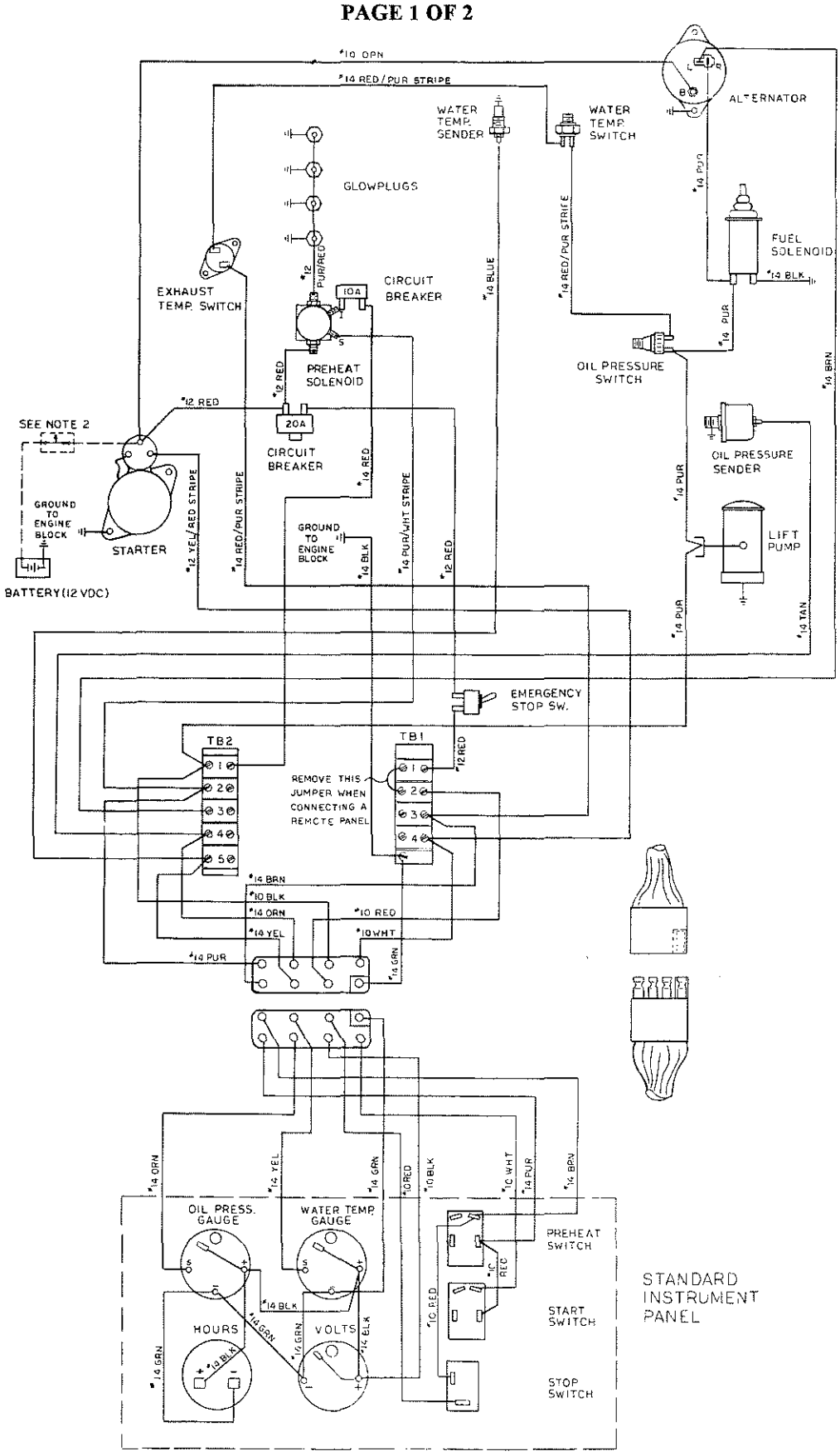
*CAUTION*

When testing the alternator circuit (charging circuit), do not use a high-voltage tester such as a megger; damaged diodes could result.

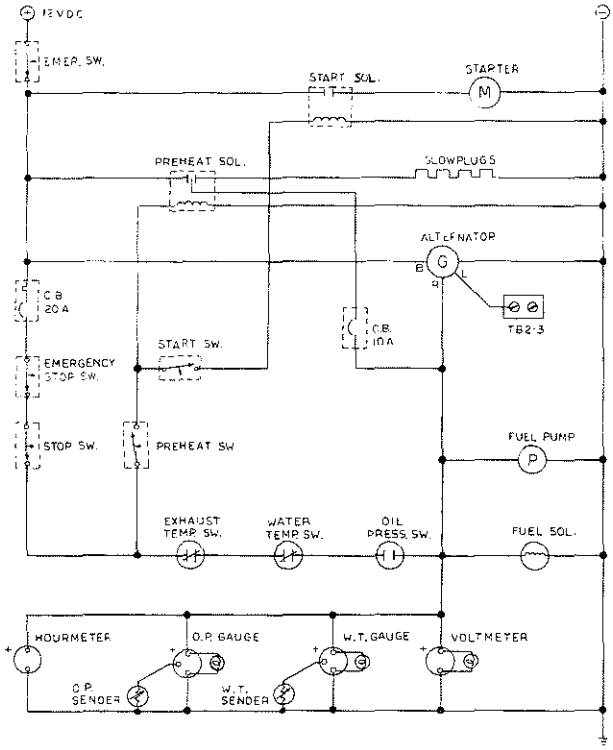
When operating the generator, do not disconnect the positive terminal of the battery from the B terminal of the alternator, nor disconnect the negative terminal of the battery from the ground.

When cleaning the engine/generator with a steam cleaner, be careful to keep steam away from the DC and AC alternators.

## DC CONTROL CIRCUIT WIRING DIAGRAM #36412
## PAGE 1 OF 2



# DC CONTROL CIRCUIT WIRING SCHEMATIC #36412
# PAGE 2 OF 2




## STARTING AND STOPPING INSTRUCTIONS

START: 1. ALWAYS PUSH PREHEAT SWITCH FIRST. HOLD FOR 15 TO 60 SECONDS AS REQ'D.

2. WHILE CONTINUING TO PUSH PREHEAT SWITCH, PUSH START SWITCH.

3. WHEN GENERATOR STARTS, RELEASE START SWITCH ONLY.

4. WHEN OIL PRESSURE REACHES APPROXIMATELY 20 PSI, RELEASE PREHEAT SWITCH (THE PREHEAT SWITCH OVERRIDES THE LOW OIL PRESSURE SHUT-DOWN CIRCUIT).

STOP: PUSH AND HOLD THE STOP SWITCH UNTIL THE GENERATOR STOPS COMPLETELY.

## NOTES:

1. THIS PRODUCT IS PROTECTED BY A MANUAL RESET CIRCUIT BREAKER LOCATED NEAR THE STARTER AND AS CLOSE TO THE SOURCE OF CURRENT AS POSSIBLE. EXCESSIVE CURRENT DRAW ANYWHERE IN THE INSTRUMENT PANEL, WIRING OR ENGINE WILL CAUSE THE BREAKER TO TRIP. IN THIS EVENT MOST GENERATORS WILL SHUT DOWN BECAUSE THE OPENED BREAKER DISCONNECTS THE FUEL SUPPLY. THEREFORE THE BUILDER/OWNER MUST BE SURE THAT THE INSTRUMENT PANEL, WIRING AND ENGINE ARE INSTALLED TO PREVENT CONTACT BETWEEN ELECTRICAL DEVICES AND SALT WATER.

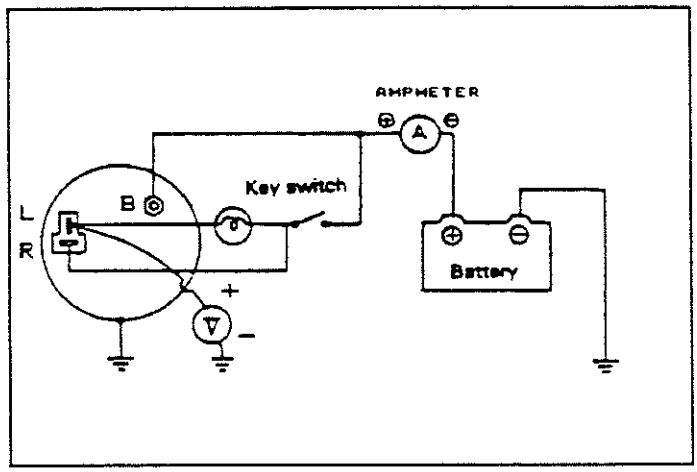
2. AN ON-OFF SWITCH SHOULD BE INSTALLED IN THIS CIRCUIT TO DISCONNECT THE STARTER FROM THE BATTERY IN AN EMERGENCY AND WHEN LEAVING THE BOAT. TWELVE VOLT DIESEL ENGINE STARTERS TYPICALLY DRAW 200 TO 300 AMPS WHEN CRANKING. THE DURATION OF INDIVIDUAL CRANKING CYCLES SHOULD NOT EXCEED 30 SECONDS. A SWITCH WITH A CONTINUOUS RATING OF 175 AMPS AT 12VDC WILL NORMALLY SERVE THIS FUNCTION, BUT A SWITCH MUST NEVER BE USED TO MAKE THE STARTER CIRCUIT.

The charging system consists of an alternator with an internal voltage regulator, an engine-mounted circuit breaker, and a battery and connecting wires.

Because of the use of IC's (integrated circuits), the electronic voltage regulator is very compact and is built into the rear bracket of the alternator.

**Charging Voltage Test**

If you suspect that the alternator is not producing enough voltage to charge the engine's battery, perform the following voltage test.




Interconnections for Charging Voltage Test

1. Using a voltmeter, connect the voltmeter's red wire clip to the B output terminal on the alternator. Refer to the schematic shown above.

2. Connect the other voltmeter wire clip to a ground on the engine.

3. Start the generator and record the reading given by the voltmeter.

The voltage reading for a properly operating alternator should be between 13.5 to 14.5 volts. If your alternator is over or under charging, have it replaced or rebuilt by a reliable service shop. Before removing the alternator for repair or replacement, ensure that 12-Volts excitation is present at the R terminal should the above test show only battery voltage at the B output terminal.

## COOLING SYSTEM

### Description

Westerbeke marine diesel engines are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to the fresh water which circulates throughout the engine. This circulating fresh water cools the engine block and its internal moving parts. The heat is transferred externally from the fresh water to sea water by means of a heat exchanger, similar in function to an automotive radiator. Sea water flows through the tubes of the heat exchanger while fresh water flows around the tubes; engine heat transferred to fresh water is conducted through the tube walls to the sea water which is pumped into the exhaust system and discharged overboard. In basic terms, the engine is cooled by fresh water, the fresh water is cooled by sea water, and the sea water carries the transferred heat over the side through the exhaust system. The fresh water and sea water circuits are independent of each other. Using only fresh water within the engine allows the cooling water passages to stay clean and free from harmful deposits. The two independent circuits and their components are discussed in the following paragraphs.

### Fresh Water Circuit

> NOTE: Refer to paragraphs **a and b** in this section on the recommended antifreeze and water mixture to be used as the fresh water coolant, and for information on filling the fresh water system.

Fresh water is pumped through the engine by a belt-driven circulating pump, absorbing heat from the engine. The fresh water coolant circulates through the engine's block absorbing heat, then passes through the thermostat into the exhaust manifold, then to the heat exchanger where it is cooled, and then is returned to the engine block through the suction side of the fresh water circulating pump. When the engine is started cold, external fresh water flow is prevented by the closed thermostat (although some fresh water flow is bypassed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens, allowing the engine's fresh water coolant to flow unrestricted to the external portion of the cooling system.

**a.** Fresh Water Coolant (Antifreeze) Mixture.

It is recommended that a fres water and antifreeze mixture be used year-round. Water, when it freezes, expands sufficiently to split the heat exchanger and crack the engine block. A water/antifreeze mixture of proper concentration will prevent feeling (see page 41 for an antifreeze/water mixture chart).

Use soft water with few impurities, such as tap water (potable water) or rainwater. Never use hard or foul water. Use of hard water or water containing impurities will lead to the collection of scale in the engine and heat exchanger which will reduce the cooling system's efficiency.

Antifreeze of poor quality or without rust inhibitors will cause corrosion within the cooling system. Always use antifreeze which is compatible with aluminum cooling system components and is made by a reliable manufacturer. Never mix different brands of antifreeze.

Make sure that the cooling system of the engine is well cleaned before adding antifreeze.

Recommended antifreeze for year round use is ZEREX or PRESTONE with rust inhibitors.

In order to control the concentration of the mixture, mix the antifreeze and fresh water thoroughly before adding it to the cooling system.

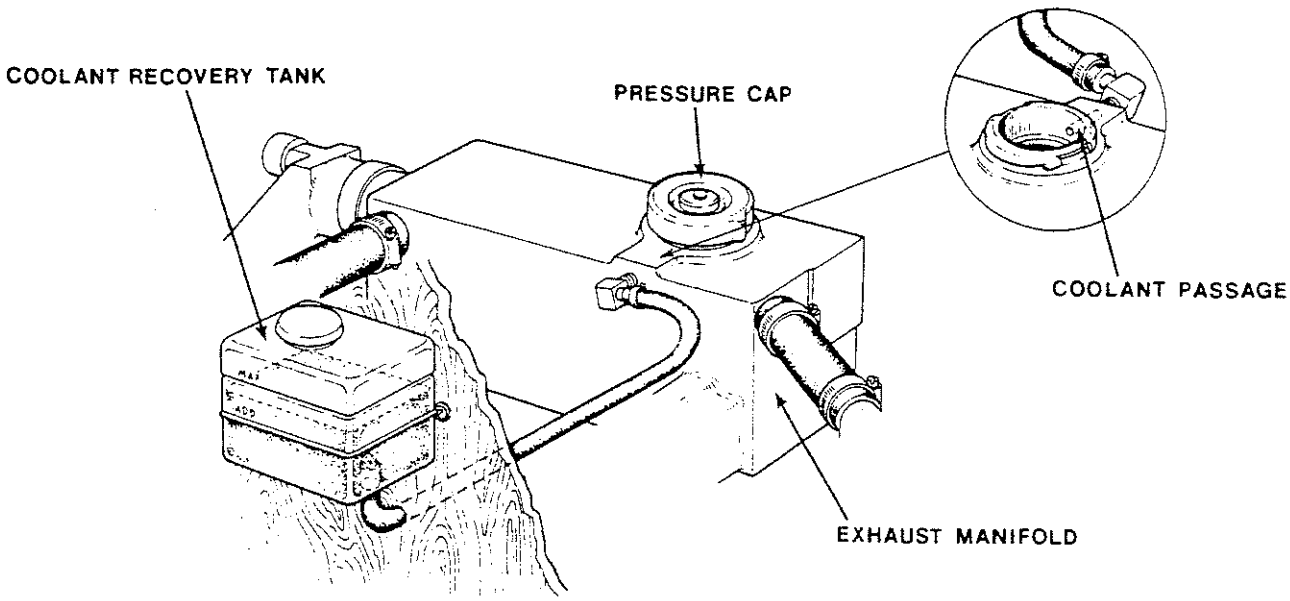
ANTIFREEZE ADDITION DATA

| Antifreeze Concentration | % | 13 | 23 | 30 | 35 | 45 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|
| Freezing Temperature | °F | 23 | 14 | 5 | -4 | -22 | -40 | -58 |
| | (°C) | (-5) | (-10) | (-15) | (-20) | (-30) | (-40) | (-58) |

**b.** Filling the Fresh Water System

A coolant recovery tank kit is supplied with each Westerbeke diesel generator. The purpose of this recovery tank is to allow for engine coolant expansion and contraction, during engine operation, without the loss of coolant and without introducing air into the cooling system.

This coolant recovery tank should be installed at, or above, engine manifold level, in a location where it can be easily monitored and where coolant can be easily added if needed (see the figure below). A stainless steel mounting bracket is supplied with each kit along with a 30-inch length of clear plastic hose and clamps to connect the hose between the engine's manifold fitting to the hose spud on the base of the recovery tank.




Coolant Recovery Tank, Recommended Installation

Coolant from the engine, when heated during the engine's operation, will expand, lift the spring-loaded manifold pressure cap, and enter the recovery tank via the hose connecting the recovery tank to the manifold.

When the engine is shut down and cools, a small check valve in the pressure cap is opened by the contraction of the engine's coolant, allowing some of the coolant in the recovery tank to be drawn back into the engine's cooling system, free of air and without loss.

Fill the fresh water system as follows:

1. Remove the pressure cap from the manifold.

2. Pour a clean, fresh water coolant mixture into the manifold and allow enough time for the coolant to fill the fresh water cooling system.

3. Replace the pressure cap on the manifold.

4. Remove the plastic cap from the coolant recovery tank and fill the tank with coolant halfway between the **ADD** mark and the **MAX** mark. Replace the cap.

5. Start and run the engine long enough for the engine to warm up so that the thermostat will open, allowing the coolant to flow through the engine block and to the rest of the fresh water coolant system.

6. Add coolant to the recovery tank, as required, to top off the fresh water coolant system.

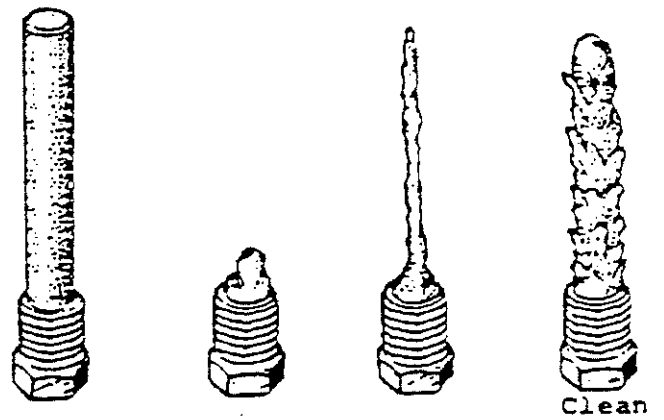
**Thermostat**

Generally, thermostats are of two types. One is simply a choking device which opens and closes as the engine's temperature rises and falls. The second type has a bypass mechanism. Usually this is a disc on the bottom of the thermostat which moves downward to close off an internal bypass passage within the head. Since 1980, each type of thermostat has a hole punched through it. The hole is a bypass to prevent the exhaust manifold from overheating during the engine's warm-up. Replacement thermostats must have this design characteristic.

**Sea Water Circuit**

The sea water flow is created by a gear-driven, positive displacement, neoprene impeller pump. The pump draws sea water directly from the ocean through the sea cock and sea water strainer and passes the water to the heat exchanger's sea water inlet. The sea water passes through the heat exchanger's tubes, from which heat from the fresh water system is absorbed, and then is discharged from the cooling system overboard through the water-injected wet exhaust system.

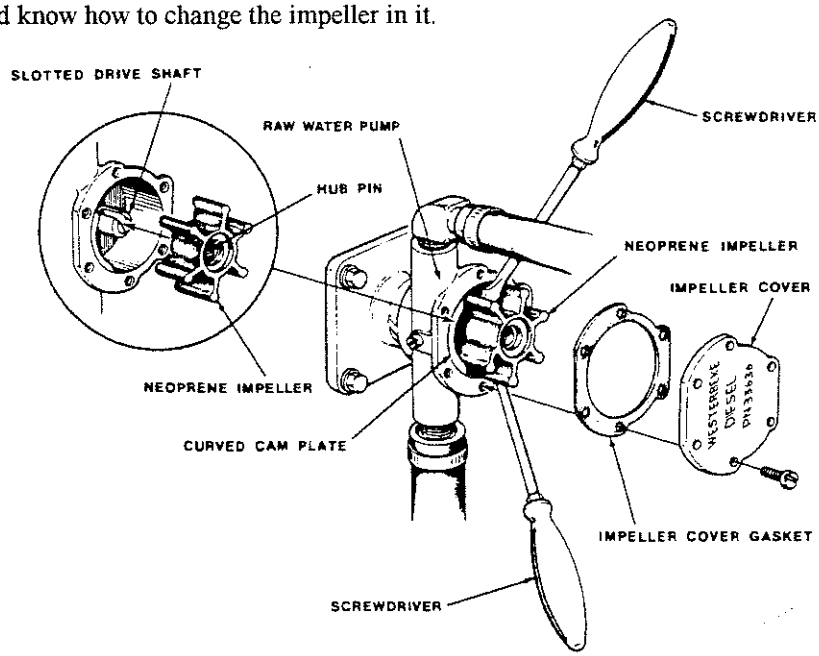
A zinc anode, or pencil, is located in the sea water cooling circuit within the heat exchanger. The purpose of the zinc anode is to sacrifice itself to electrolysis on other components of the system. The condition of the zinc anode should be checked monthly and the anode cleaned or replaced, as required. Spare anodes should be carried on board.




Zinc Anode Conditions

### Raw Water Pump

The raw water pump is a self-priming, gear-driven, rotary pump with a non-ferrous housing and a neoprene impeller. The impeller has flexible vanes which wipe against a curved cam plate within the impeller housing, producing the pumping action. **On no account should this pump be run dry.** There should always be a spare impeller and impeller cover gasket aboard (an impeller kit). Impeller failures occur when lubricant (raw water ) is not present. Such failures are not warrantable and the operator's are cautioned to make sure raw water flow is present at start-up. Know your pump, know its location on the engine and know how to change the impeller in it.




Remove the impeller with the aid of two small screwdrivers, as illustrated, and carefully pry the impeller out of the pump. Install the impeller by positioning the hub pin to align with the slot in the drive shaft. Move the blades to conform to the curved cam plate and push the impeller into the pump's housing.

### Water Pump Drive Belt Tension

Generator models come equipped with belt guards that cover over the belt(s) on the front of the engine. ("Out of sight-out of mind." The belt guard is not installed for that purpose.) Operators are advised that the inspection, service, and maintenance spoken of below should be followed.

*WARNING*

**Never** attempt to adjust the drive belt's tension while the engine is in operation.

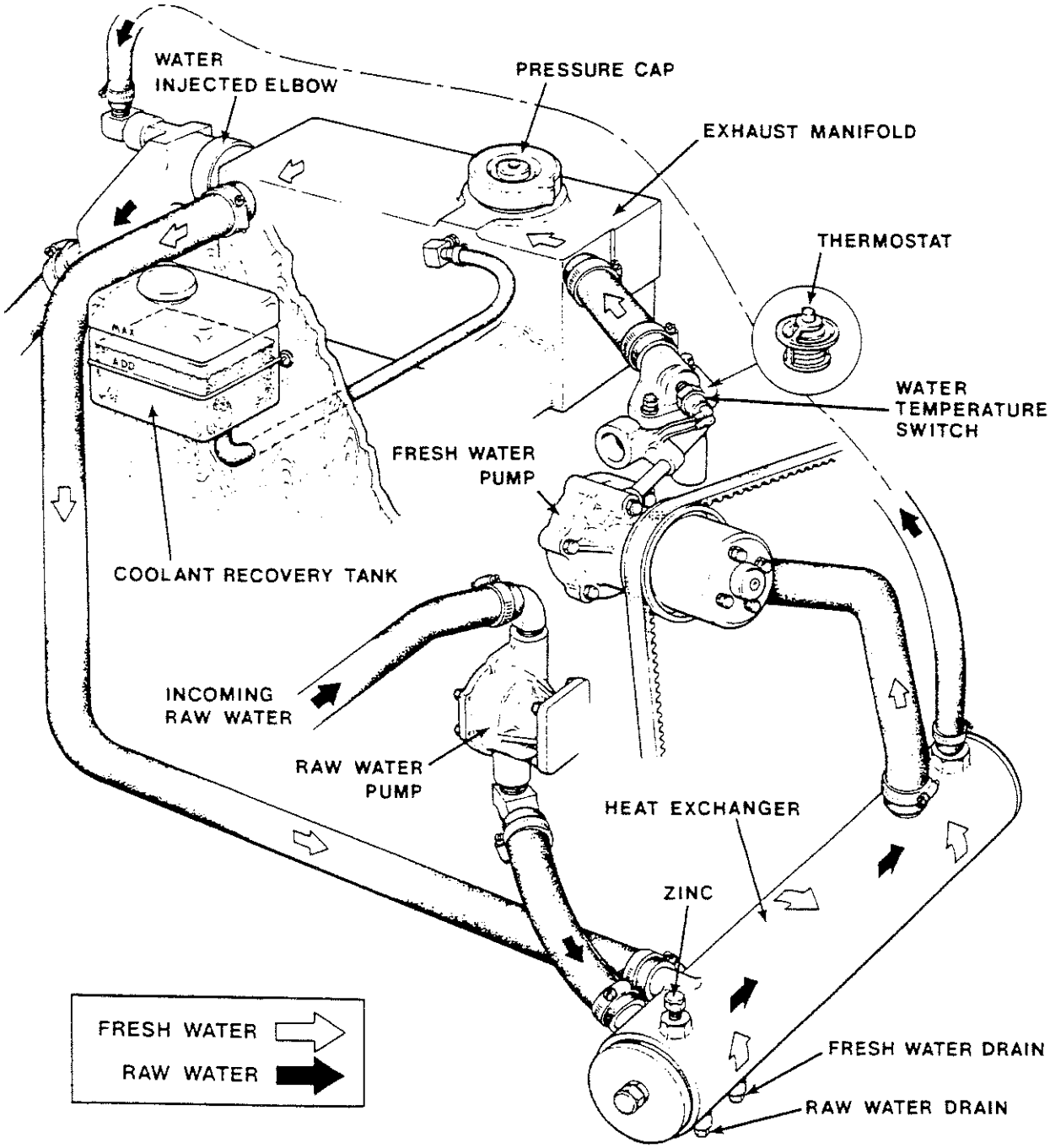
*CAUTION*

Excessive water pump drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump's bearings. Excessive slack or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures.

The water pump drive belt is properly adjusted if the belt can be deflected no less than 3/8 inch and no more than 1/2 inch (10 mm, 12 mm) as the belt is depressed with the thumb at the midpoint between the two pulleys on the longest span of the belt. A spare drive belt should be carried on board.

**Cooling System**

Illustrated below is a typical Westerbeke engine cooling system. Both fresh water and raw water flow through their independent cooling circuits. Refer to your generator's Parts List for part numbers and part descriptions if you need to order cooling system parts for your engine.



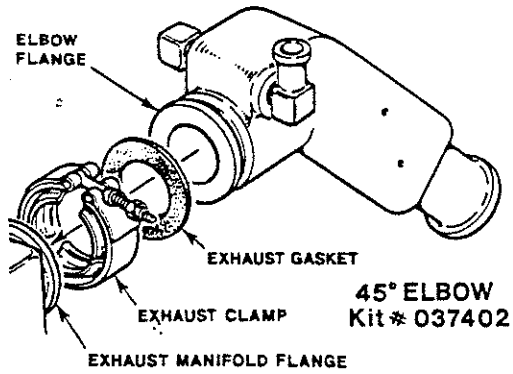

Typical Cooling System

**Exhaust Elbow Installation**

The Westerbeke Corporation offers a 45° and 90° exhaust elbow as well as an exhaust riser you can install on your propulsion engine. Refer to the instructions below when installing the exhaust elbow purchased for your generator.

NOTE: Fabricated exhaust elbows or risers attached to the exhaust manifold **shall not exceed 8 lbs when unsupported.**

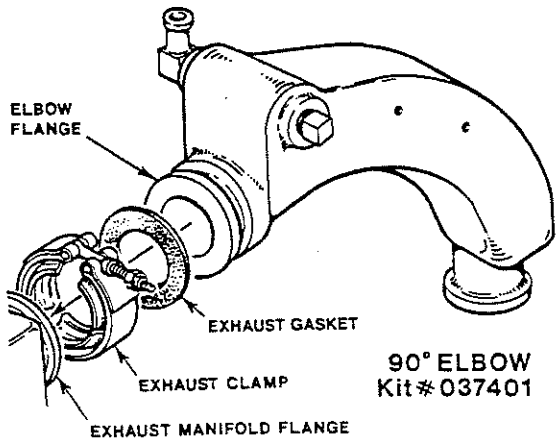
1. Coat only one side of the exhaust gasket with "High Tack" adhesive sealant. Place this coated surface against the exhaust manifold's exhaust port flange (the gasket should stick to the flange without falling off).




2. Place the clamp over the elbow's flange. Place your exhaust elbow against the exhaust manifold's flange so the exhaust manifold's flange rests snug against the exhaust elbow's flange with the gasket centered between the two. Now slip the exhaust clamp over both flanges.

3.A. Tighten the clamp just enough so the exhaust elbow can remain attached to the manifold and still be rotated.

B. The exhaust elbow discharge *must* be directed **downward** so the mixture of raw water and exhaust gases will flow/fall downward into the exhaust muffler which *must* be positioned below the exhaust elbow. There should be no loops or rises in the exhaust hose between the exhaust elbow and the muffler, as these would trap water and possibly allow water to flow back into the engine during starting or at shut down causing internal damage to the engine.




4. Adjust the elbow by rotating it until the desired alignment with the exhaust piping is acquired.

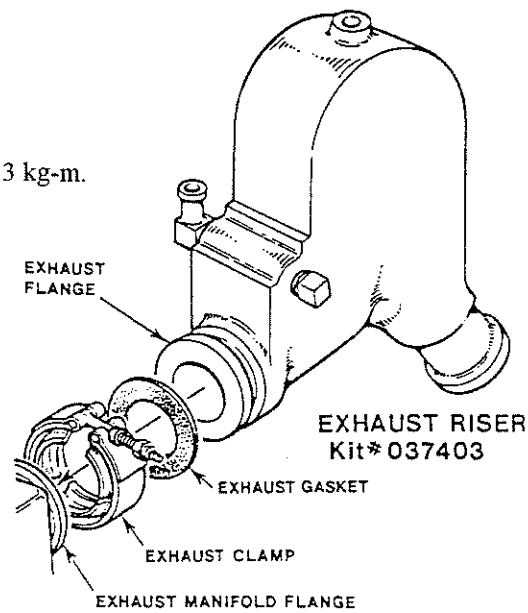
5. Carefully tighten the clamp between 8 to 10 lb-ft, or 1.1 to 1.3 kg-m.

*CAUTION*

Approach the10 lb-ft torque limit with caution. The clamp's threads will break if more than 10 lb-ft is applied to the clamp.

If a leak exists, correct it immediately.

*Manufactured by Permatex Company, Brooklyn, N.Y.



## LUBRICATION SYSTEM

### Engine Oil

For engine lubrication, use lubricating oil designated for diesel service. These oils are classified according to the API specifications into service grades CA, CB, CC and CD. The use of CCor higher (CD) grades made by well-known manufacturers is recommended. The oil selected should be used thereafter.

### Engine Oil Viscosity (SAE Number)

Use oil having a viscosity best suited to the atmospheric temperature. Use of an all-season oil SAE 10W-30 with minimum viscosity change under different temperatures is suggested.

| Atmospheric Temperature | Viscosity |
|---|---|
| 68° F (20°C) or higher | SAE 30 or 10W - 30 |
| 41° F (5° C) - 68° F (20° C) | SAE 20 or 10W - 30 |
| 41° F (5° C) - or lower | SAE 10W - 30 |

NOTE: Do not use engine lube oil with an SAE number greater than 30 in generator engines.

### Oil Pressure

The engine's oil pressure is indicated by the oil pressure gauge.

During normal operation, the engine's oil pressure will range between 35 and 70 psi (engine hot).

> NOTE: A newly started, cold engine can have an oil pressure reading upwards of 60 to 80 psi. A warmed engine can have an oil pressure reading as low as 35 psi. These readings may also vary depending upon the load that is placed on the generator.

Your generator set is fitted with an oil pressure switch. Should your engine's oil pressure drop below a safe operating pressure, the switch will open and shut the engine OFF to prevent any internal damage to your generator's engine from occurring.

### Engine Oil Change (to include filter)

1. Draining the Oil Sump

Discharge the old oil through the sump drain hose (attached at the front of the engine) while the engine is still warm. Drain the old oil completely, replace the hose in its bracket and replace the end cap securely.

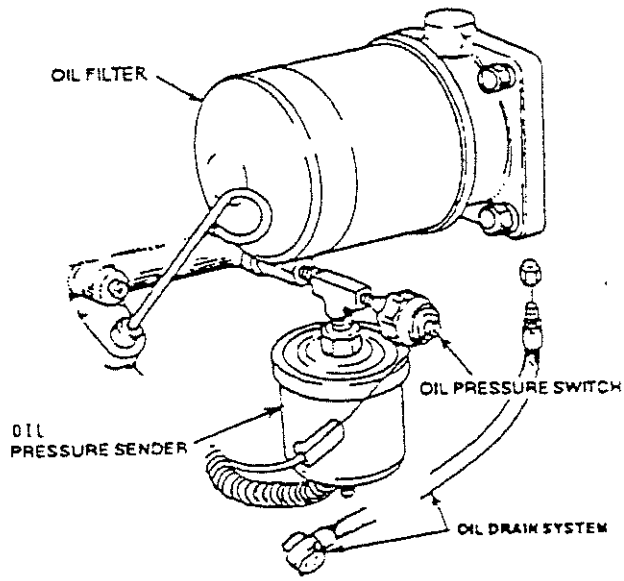
Always observe the old oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic should water be present in the oil. Sea water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a syphoning through the sea water cooling circuit into the exhaust, filling it up into the engine (refer to the installation illustrations in this manual.)

2. Replacement of the Oil Filter

When removing the used oil filter, cover the filter with a plastic bag containing a few cloth rags or paper towels. This will allow both the filter element and spilled oil to be collected cleanly without spilling oil on the engine or in the bilge. (Oil or any other fluid on the engine reduces the engine's cooling ability. Please keep your generator's engine clean.)

The replaceable cartridge-type oil filter requires no cleaning inside.

When installing the oil filter element, apply a thin coat of clean engine oil to the rubber gasket on the oil filter, screw the filter onto the threaded oil filter stub, and then tighten the filter firmly by hand. (See page 79 for the proper tightening specification for oil filters.)




Oil Filter and Oil Drain System

NOTE: Operators are advised that replacement oil filters supplied by Westerbeke Corporation may vary in size from the original oil filter supplied with the engine (i.e.- replacement filter is larger). This is due to commonizing of oil filters between engine models. The smaller original oil filters on some models are there only for the initial break-in period.

NOTE: Generic filters are not recommended, as the material standards or diameters of important items on generic parts might be entirely different from genuine parts.

NOTE: Immediately after an oil filter change and oil fill, run the engine to ensure that the oil pressure is normal and that there are no oil leaks around the new oil filter.

3. Filling the Oil Sump

Add fresh oil through the oil filter cap on the valve cover. After refilling the oil, run the engine for a few moments while checking the engine's oil pressure. Ensure there is no leakage around the new oil filter or from the oil drain system, and then stop the engine. Then check the quantity of oil with the dipstick. Fill to, but not over, the high mark on the dipstick, should the engine require additional oil.

# BT GENERATOR

This generator is a brushless self-excited generator, which requires only the driving force of the engine to produce AC output. The copper and laminated iron in the exciter stator are responsible for the self-exciting feature of this generator. The magnetic field produced causes an AC voltage to be induced into the related exciter rotor windings during rotation. Diodes located in the exciter rotor rectify this voltage to DC and supply it to the windings of the rotating field. This creates an electromagnetic field which rotates through the windings of the main stator, inducing AC voltage which is supplied to a load. A transformer is connected in parallel to the AC output of the main stator. An AC voltage is produced in the auxiliary windings of the transformer and main stator and is, in turn, supplied to a full-wave bridge rectifier. The rectifier produces a DC voltage to further excite the exciter stator windings, enabling the generator to produce a rated AC output.

An optional solid-state voltage regulator is available to work in tandem with the transformer regulator to produce a more stable AC output.

**No-Load Adjustment**

Voltage adjustment is made with the compound transformer governing generator regulation.

1. The seletor switch must be in the COMP position.

2. Operate the generator and apply a moderate load momentarily; then remove the load. Note the voltage output from the generator's 120-Volt leg(s) (220 Volts at 50 Hertz). The no-load voltage should be between 118 - 128 Volts at 61.5 - 62 Hertz (218 - 228 Volts at 51.5 - 52 Hertz).

> **NOTE:** The no-load voltage should be adjusted to the voltage produced by the generator when : the generator is started, a momentary load is applied to excite the transformer, and then removed. The voltage produced by the generator after this momentary load is removed is the no-load voltage.

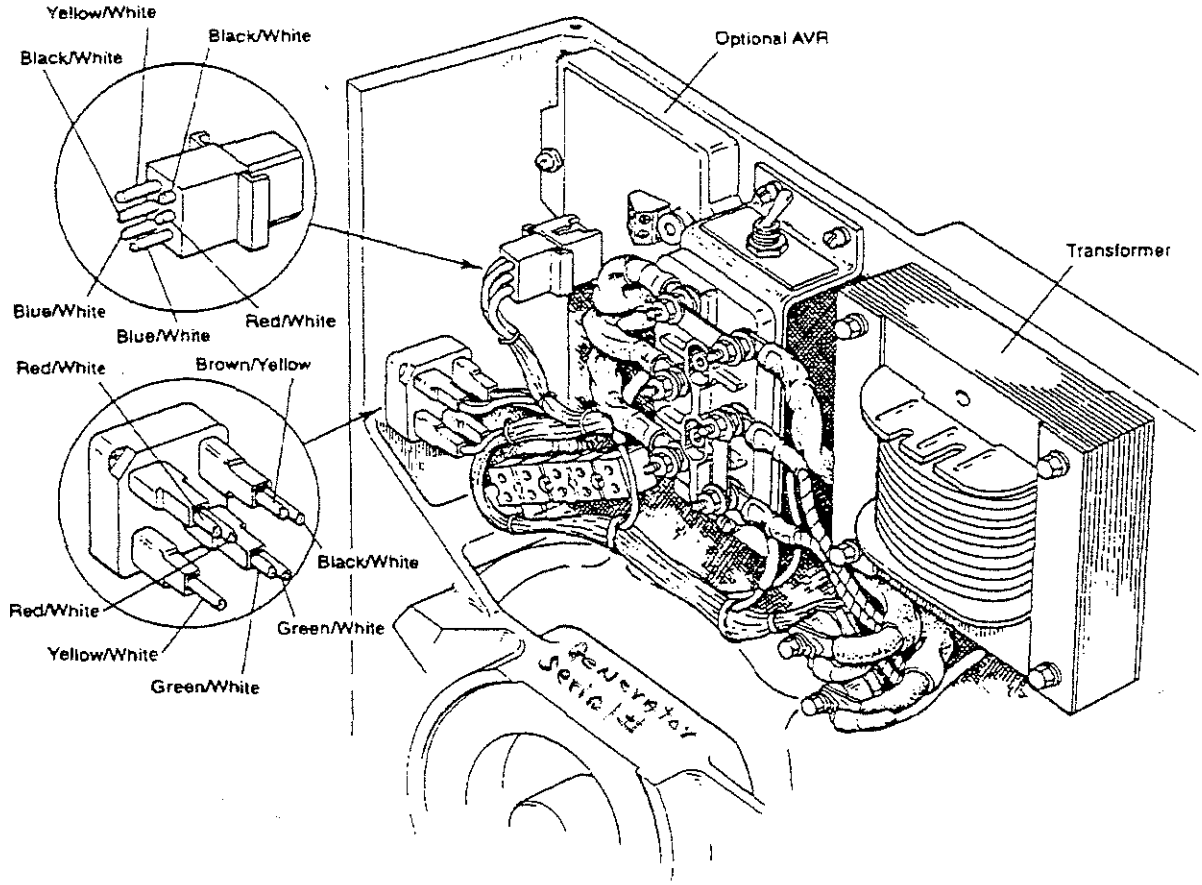
3. To raise or lower the voltage, non-conductive shims of varying thickness are inserted or removed from under the laminated steel bar that is situated on top of the compound transformer. The material used for shimming should not soften at temperatures in the 176° F (80° C) range. A small reduction in no-load voltage (1 to 3 volts) sometimes can be accomplished by gently tapping the top of the laminated steel bar to reduce the air gap between the existing shims and the transformer core.

***CAUTION***

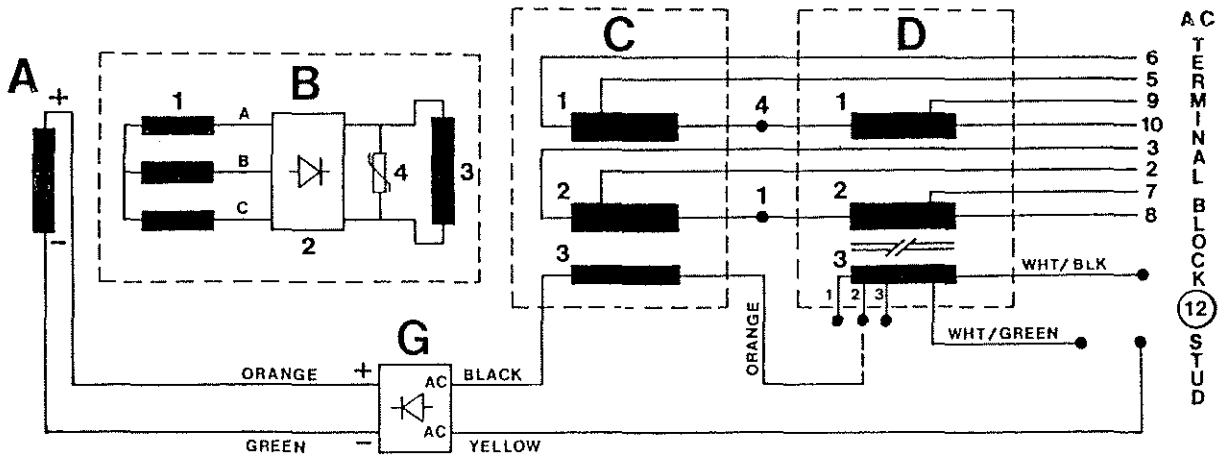
> Under no circumstances attempt to increase the no-load voltage by increasing the gap between the laminated steel bar and the transformer core without the use of shims. Magnetic forces created within the transformer during the generator's operation may close the air gap and reduce the no-load voltage output.

4. To remove the laminated steel bar, remove the two upper securing bolts from the compound transformer and lift the bar from the transformer. The addition of shim thickness will raise the no-load voltage and conversely, the removal of the shim thickness will lower the no-load voltage.
*Varying shim thickness by .001 inch (0.025 mm) will change the no-load voltage by 4 to 6 Volts.*

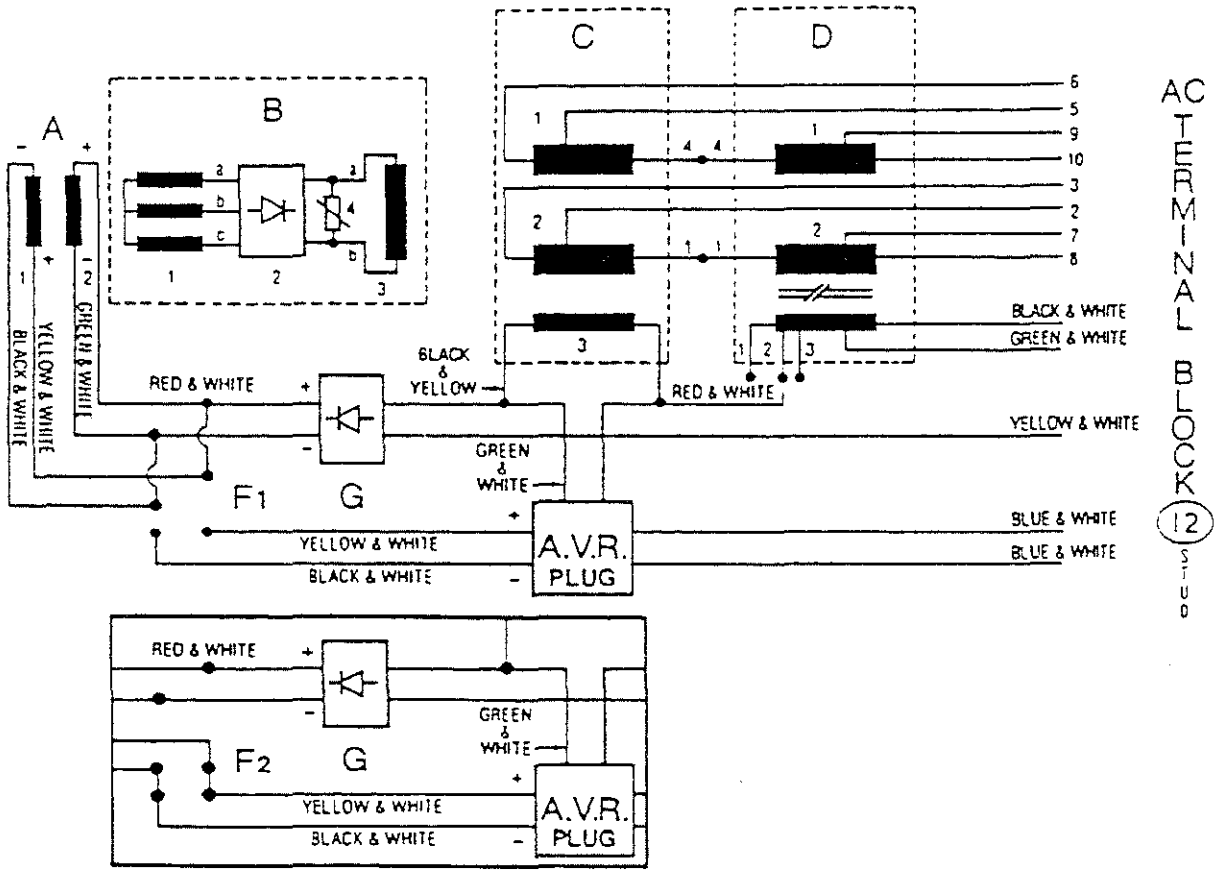
## GENERATOR AC DISTRIBUTION BOX
## BTD 10.0KW, 11.0KW, AND 12.5KW (A)




**Internal Wiring Schematic for 12 Stud BT Model with Voltage Regulator Circuit Removed**




COMPONENTS LISTED ON FOLLOWING PAGE.




Early Model BTD 8.0KW Generator's Internal Wiring Diagram with A.V. R. Circuit

A. EXCITER STATOR WINDINGS
   1. Exciter Stator Windings
   2. Exciter Stator Windings

B. EXCITER ROTOR
   1. Auxiliary Windings (a-b-c)
   2. Diodes (6)
   3. Rotating Field Windings
   4. Pozi Resistor

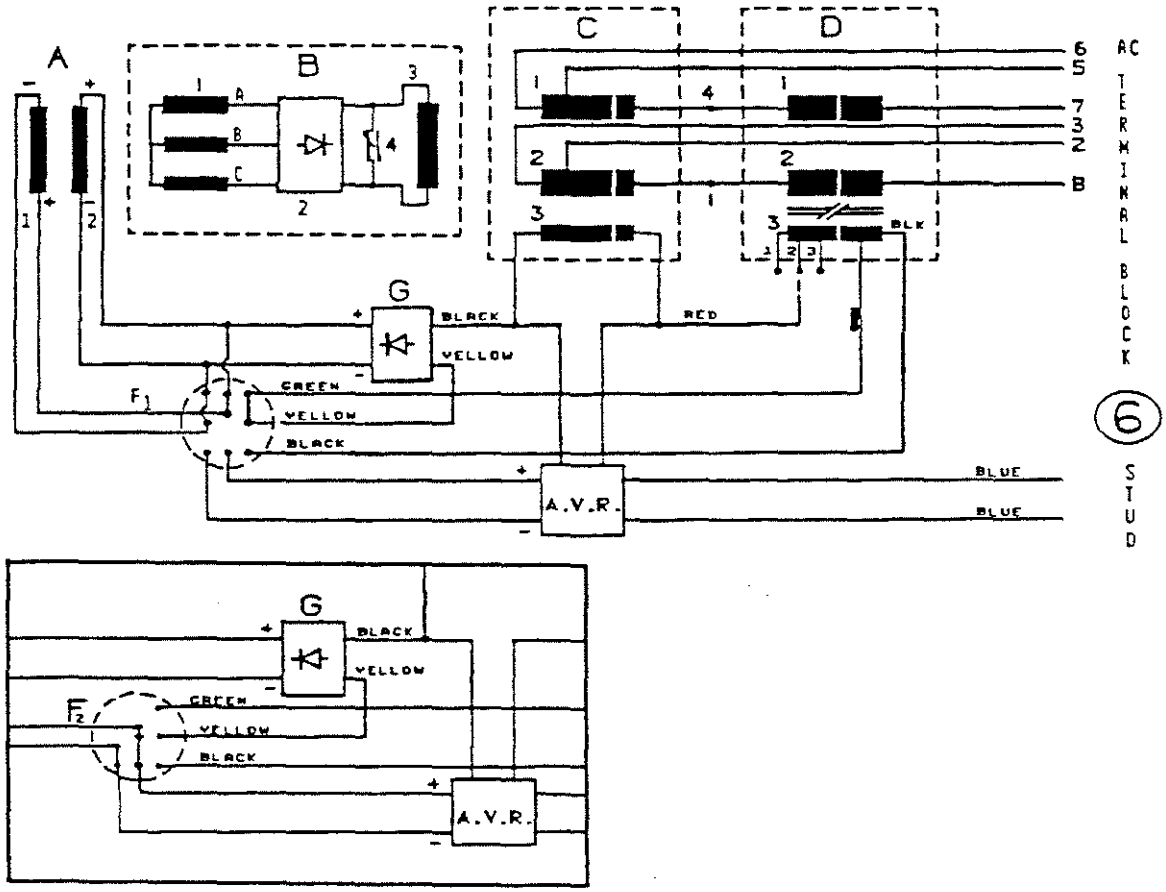
C. MAIN STATOR
   1. Main Stator Windings
   2. Main Stator Windings
   3. Main Stator Auxiliary Windings

D. COMPOUND TRANSFORMER
   1. Compound Transformer Windings
   2. Compound Transformer Windings
   3. Compound Transformer Auxiliary Windings

E. SELECTOR SWITCH
   1. Compound
   2. Electronic and Compound

G. BRIDGE RECTIFIER

(Optional A.V.R. - Automatic Voltage Regulator)




BTD 10.0KW, BTD 11.0KW, & BTD 12.5KW (A) Generator's Internal Wiring Diagram

A. EXCITER STATOR WINDINGS
   1. Exciter Stator Windings
   2. Exciter Stator Windings

B. EXCITER ROTOR
   1. Auxiliary Windings (a-b-c)
   2. Diodes (6)
   3. Rotating Field Windings
   4. Pozi Resistor

C. MAIN STATOR
   1. Main Stator Windings
   2. Main Stator Windings
   3. Main Stator Auxiliary Windings

D. COMPOUND TRANSFORMER
   1. Compound Transformer Windings
   2. Compound Transformer Windings
   3. Compound Transformer Auxiliary Windings

E. SELECTOR SWITCH
   1. Compound
   2. Electronic and Compound

G. BRIDGE RECTIFIER

(Optional A.V.R. - Automatic Voltage Regulator)

**Optional Voltage Regulator**

An optional solid-state voltage regulator (board #34410) is available for use with the BT series generators. When installed, and the regulation switch is moved to the ELEC position, the regulator works together with the standard compound transformer regulator to regulate the generator's voltage output. In the ELEC mode, the regulator excitation to the group 1 exciter windings, and the transformer provides excitation to the group 2 exciter windings.

**Installation**

1. The regulator is mounted using existing tapped holes in the generator's case. Use two (2) M4 × 0.7 mm screws, each 15 mm long, with lock washers to mount the regulator board.

2. Connect the 6-prong generator plug to the receptacle on the regulator board. Note: The plug is keyed to engage the regulator receptacle in one direction. Check this and insert it correctly.

3. Before moving the selector switch to ELEC, ensure that the no-load voltage produced by the generator is properly adjusted. The no-load voltage desired with the selector switch in the COMP position must be slightly lower than the voltage desired with the regulator in the circuit.
(i.e. 120 volts 60 Hertz no-load voltage in COMP 116 - 118 volts for 50 Hertz 216 - 218 volts.)

4. With the no-load voltage adjusted in COMP move the selector switch to ELEC position. Adjust the regulator potentiometer to bring the no-load voltage up to 120 volts at 60 Hertz and 220 volts at 50 Hertz. The potentiometer adjustment must not be used to force the no-load voltage down.

**Generator Frequency**
Frequency is a direct result of engine/generator speed:

1800 RPM - 60 Hertz
1500 RPM - 50 Hertz

To change the generator's frequency, refer to the "Maintenance and Adjustments" section of this manual.

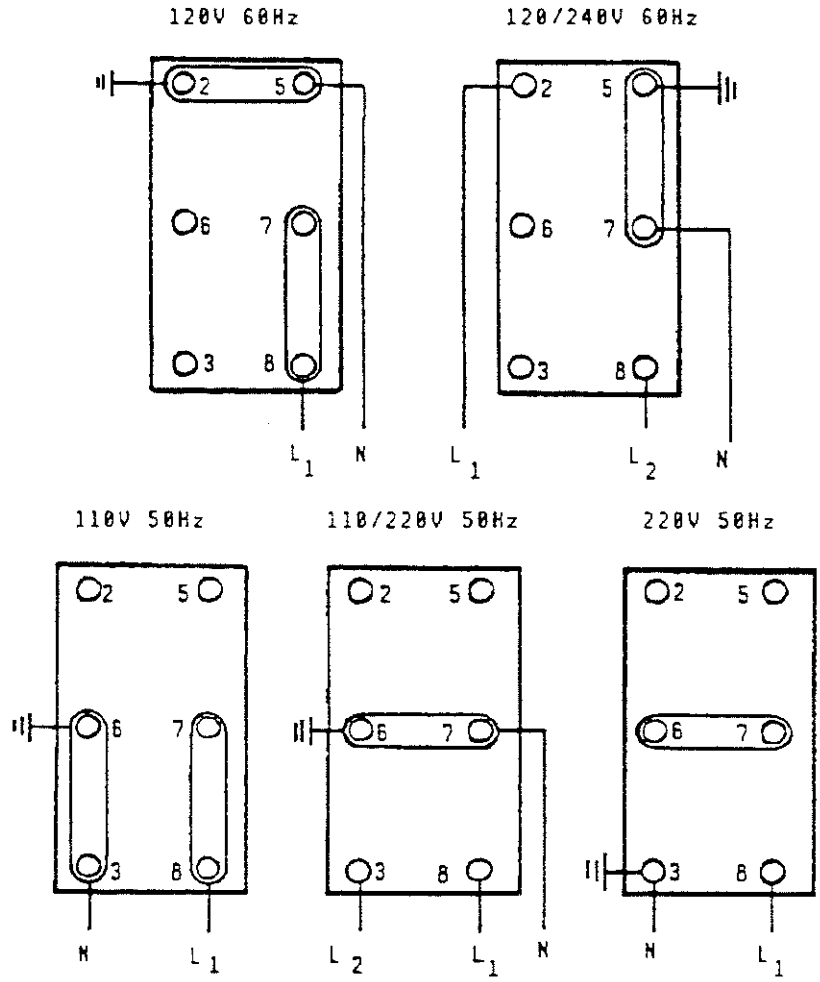
**Load Connections**

The generator's data plate gives the voltage, current and frequency rating of the generator. An AC wiring decal is affixed to the inside of the louvered cover on the generator end. A diagram of the various AC voltage connections is provided on the decal. The information on the decal is similar to the figure shown on the following page.

The generator is a single-phase, reconnectable 120 Volts AC two-wire or 120/240 Volts AC three-wire at 60 Hertz; or 220 Volts AC two-wire at 50 Hertz. Refer to the "System Specifications" section of this manual for ratings.

NOTE: We recommend that the installer provide AC ampmeters (optional) so that the operator can observe the load being taken off each leg of the generator.

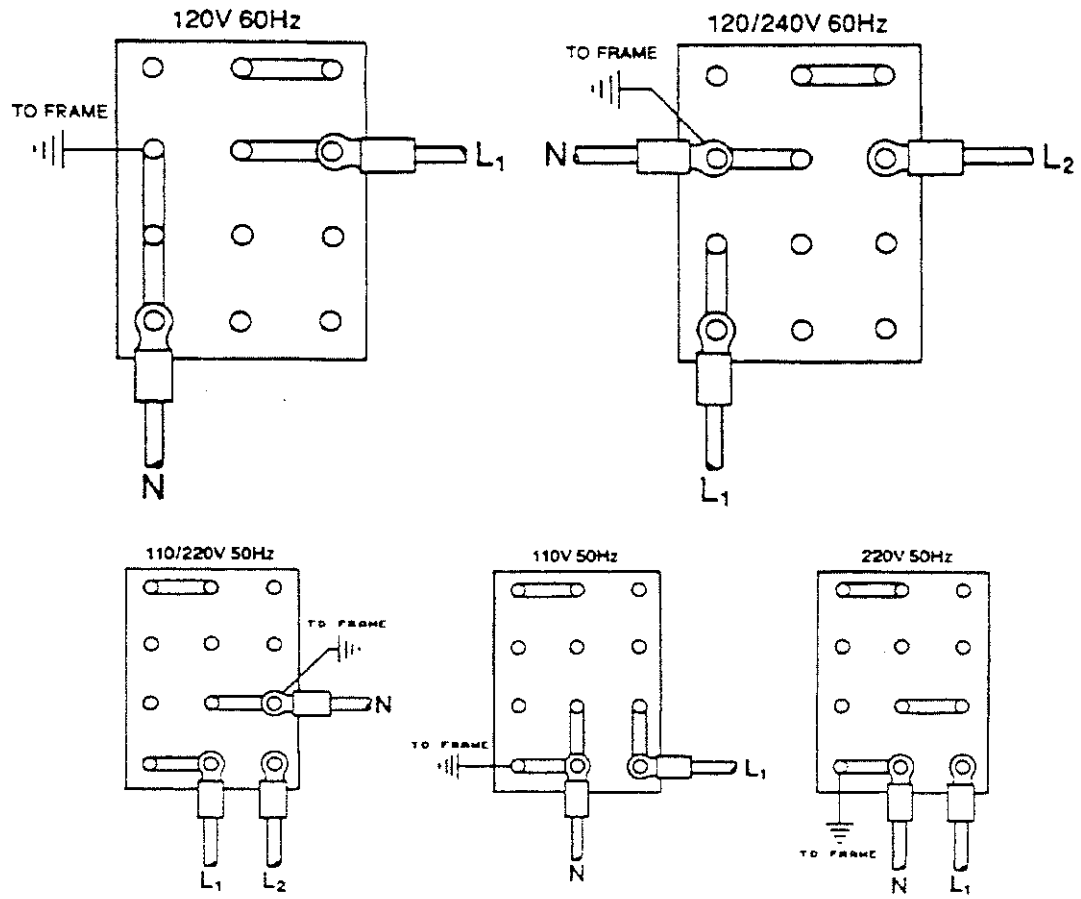
A circuit breaker should be installed between the generator and the AC load. This circuit breaker should be rated for the generator's AC output and be able to react quickly to overloads, subject to motor starting considerations.




AC Voltage Connections (6 Stud Terminal Block)
(Used with the BTD 10.0KW, 11.0KW, and the 12.5KW(A) (Generator Sets.)

NOTE: The frame ground wire must be moved when changing from 110 Volts, 50 Hertz to 220 Volts, 50 Hertz.

For making connections to the AC terminal block, use 1/4 inch terminal ends that will accept multi-strand wire sized for the number of conductors in the bundle, the rating of the conductor's insulation, and amperage that will be drawn through the conductor(s). (Refer to the generator's scarlet and gold data plate for generator amperage ratings.



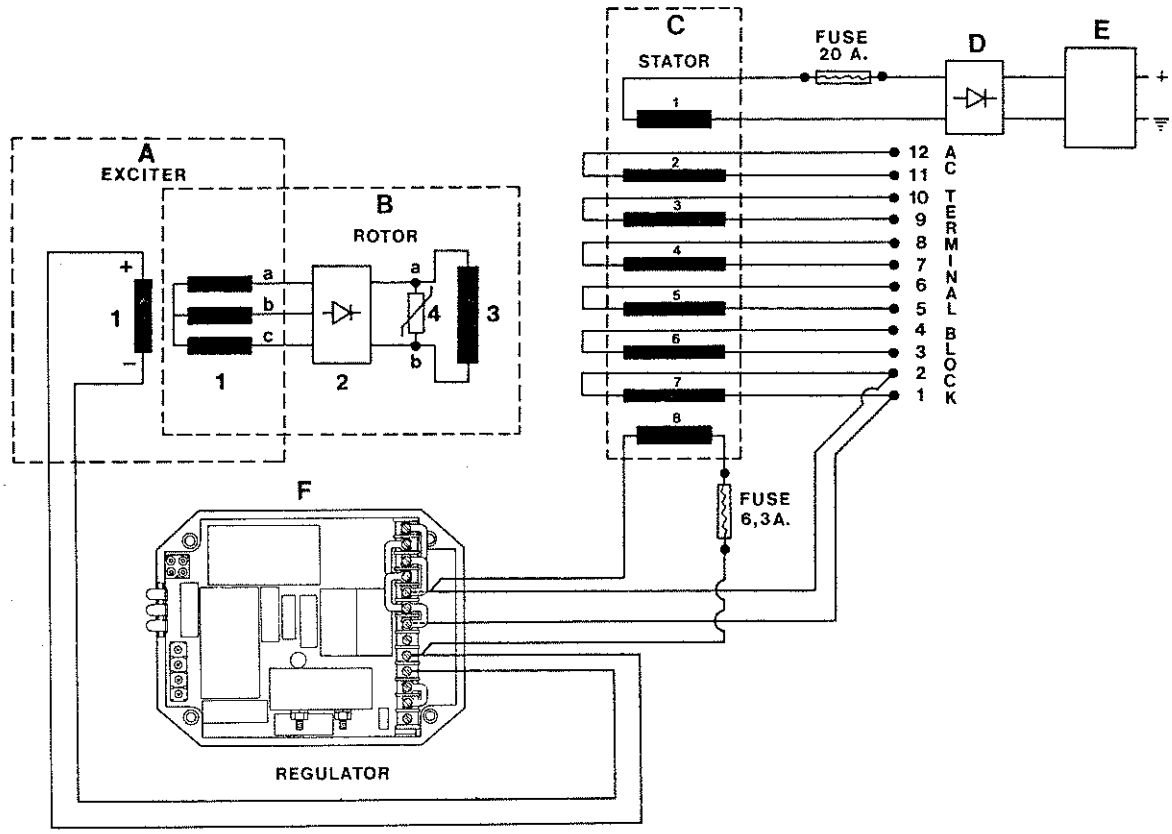

AC Voltage Connections (12 Stud Terminal Block)
(Used only with the BTD 8.0 KW Generator Set.)

NOTE: The frame ground wire must be moved when changing from 110 Volts, 50 Hertz to /220 Volts, 50 Hertz.

For making connections to the AC terminal block, use terminal ends for #10 studs which will accept #6 or #8 multi-strand wire.

## INTERNAL WIRING SCHEMATIC
## 3 PHASE GENERATOR

### MODELS 10.0 BTD 11.0 BTD & 12.5 BTD




A. Exciter
   1. Exciter Stator Windings

B. Rotor
   1. Auxiliary Exciter Windings (a-b-c)
   2. Diodes (6)
   3. Main Rotor Windings
   4. Pozi Resistor

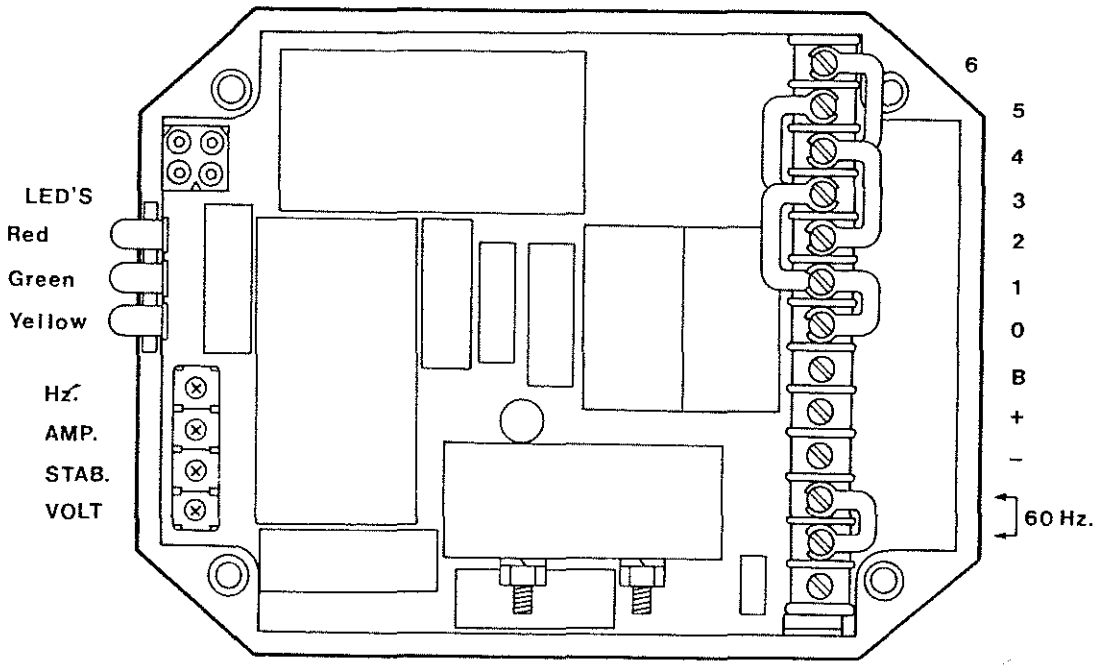
C. Main Stator
   1. Auxiliary Windings (DC Charging Circuit)
   2-7. Main Stator Windings
   3. Auxiliary Windings (AC to Regulator)

D. Bridge Rectifier

E. DC Controller

F. Voltage Regulator Board

## VOLTAGE REGULATOR #038468
### Single & Three Phase




The voltage regulator is of an advanced design which ensures optimum AC alternator performance. The regulator is equipped with complete protection circuitry to guard against operating conditions that could be detrimental to the AC alternator.

Adjustments:

1. Volts - This potentiometer is used to adjust AC output voltage. It has an additional range of ± 25-30 volts. At proper engine operating speed the output voltage should be held at ± 1% from a no-load condition to full rated generator output and from power factor 1.0 - 0.8 with engine drive speed variation of up to -6%.

2. Stability - This potentiometer permits variation of the regulators response to generator load changes so as to limit over-compensation and obtain a minimum recovery time to the normal voltage output.

3. Amp/Hertz - These two adjustments are used in conjunction with the two protection circuits in the voltage regulator that are indicated by illumination of a colored LED.

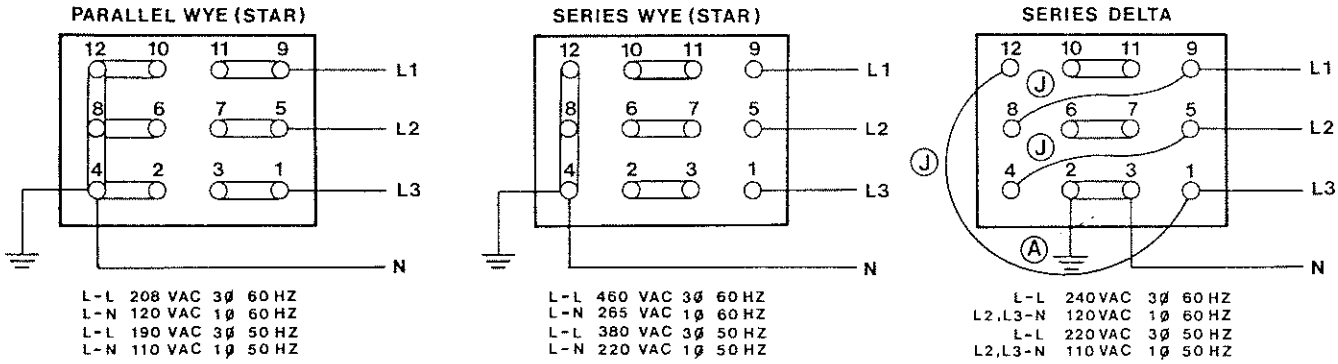
1) Delayed overload protection (YELLOW RED)

2) Low speed protection (RED LED)

Each of these two protection circuits reduces exciter voltage to safeguard the exciter windings and prevent overheating of the AC alternator. These two potentiometers are factory adjusted and sealed and should not be tampered with.

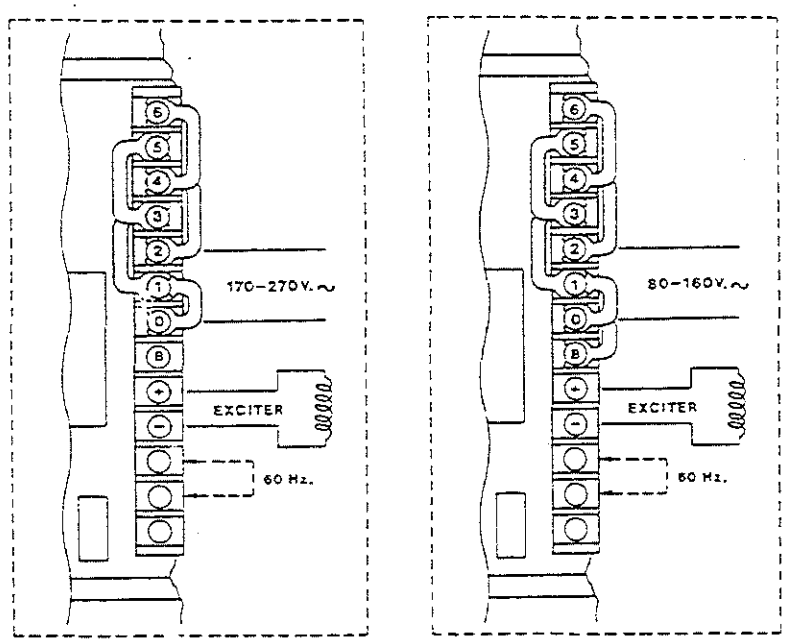
4. Proper Generator Operation (GREEN LED) - The overload protection system has a delay which permits temporary overloading of the generator during times such as motor start-up or other similar load surge demands.

## 3 PHASE AC TERMINAL BLOCK CONNECTIONS FOR WYE AND DELTA CONFIGURATION



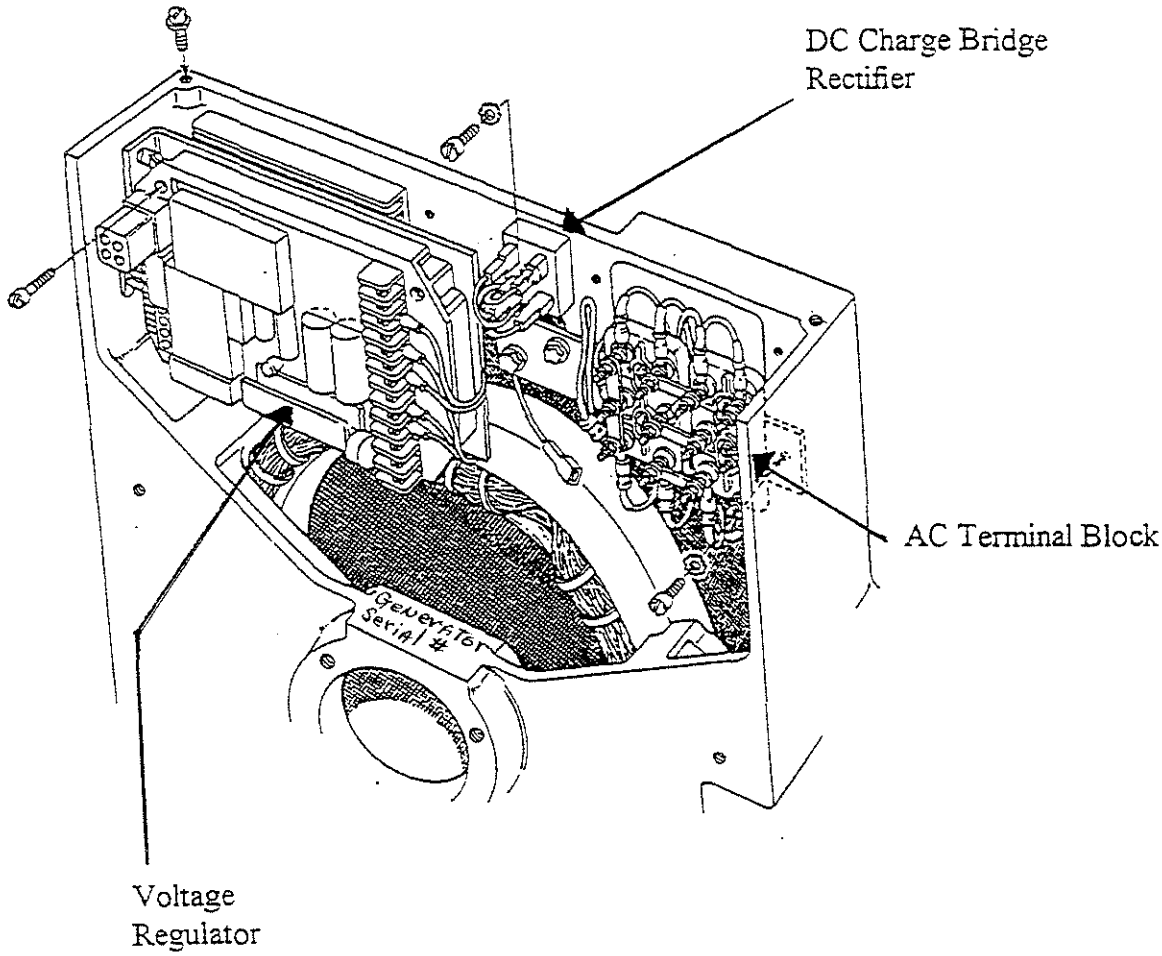

The regulator is equipped with 7 numbered terminals and related brass jumpers. The illustration below shows the connection points and jumpers for the 3 phase configuration of the generator. The sensing leads connect between pin #1 and pin #2 on the AC terminal block and connection #2 and #0 on the regulator board.

NOTE: Series DELTA requires the installation of a jumper on the regulator board between terminal B and O.




WYE DELTA

The illustration below shows the 3 phase AC generator backened with the louvered covers removed.

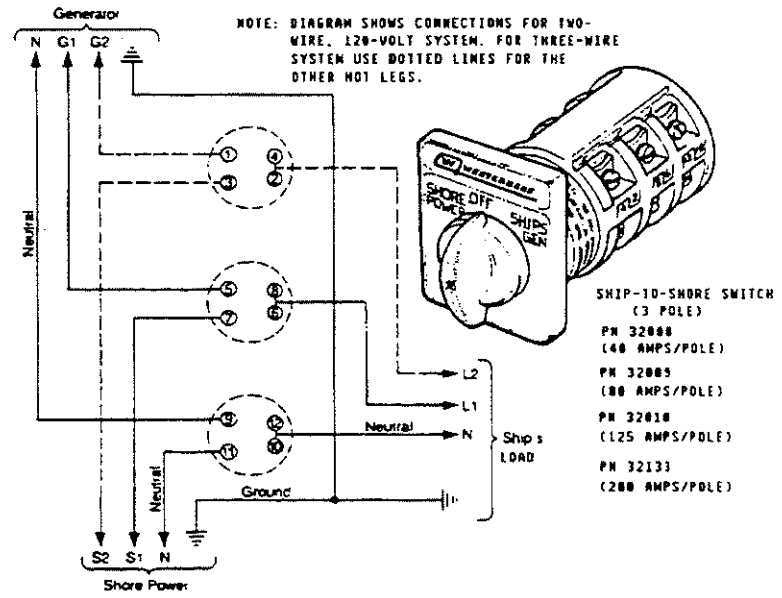


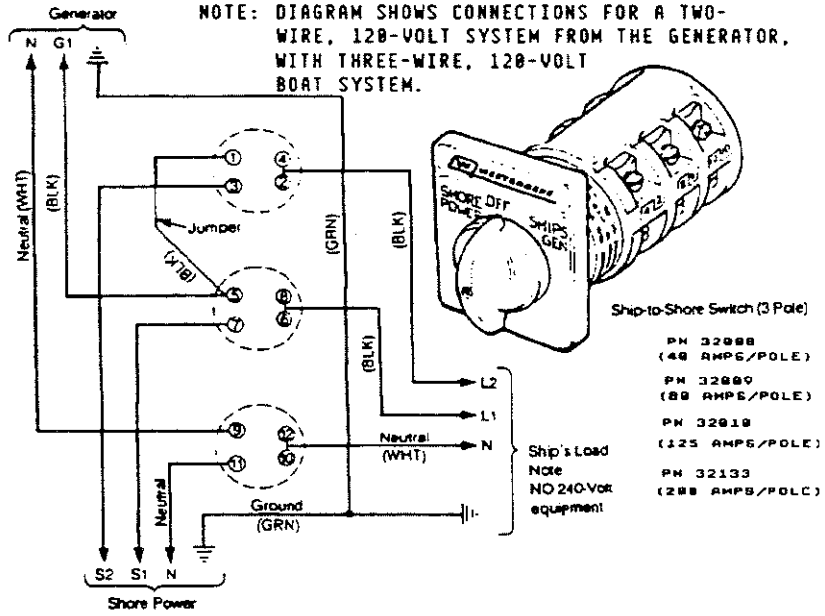
**Shore Power Connections**

If the installer connects shore power to the vessel's AC circuit, this must be done by means of the SHORE POWER/OFF/SHIPS GEN, center position-off transfer switch as shown below. Use of this switch prevents simultaneous connection of shore power to generator output.

***CAUTION***

Damage to the generator can result if utility shore power and generator output are connected at the same time. This type of generator damage is not covered under the warranty; it is the installer's respnsibility to ensure that all AC connections are correct.




Shore Power Switch Connection Diagrams

### Use of Electric Motors

The power required to start an electric motor is considerably more than is required to keep it running after it is started. Some motors require much more current to start than others. Split-phase (AC) motors require more current to start, under similar circumstances, than other types. They are commonly used on easy-starting loads, such as washing machines, or where loads are applied after the motor is started, such as small power tools. Because they require 5 to 7 times as much current to start as to run, their use should be avoided, whenever possible, if the electric motor is to be driven by a small generator. Capacitor and repulsion-induction motors require from 2 to 4 times as much current to start as to run. The current required to start any motor varies with the load connected to it. An electric motor connected to an air compressor, for example, will require more than a motor to which no load is connected.

In general, the current required to start 115-Volt motors connected medium starting loads will be approximately as follows:

| MOTOR SIZE (HP) | AMPS FOR RUNNING (Amperes) | AMPS FOR STARTING (Amperes) |
|---|---|---|
| | | |
| 1/6 | 3.2 | 6.4 to 22.4* |
| 1/4 | 4.6 | 9.2 to 32.2* |
| 1/3 | 5.2 | 10.4 to 72.8* |
| 1/2 | 7.2 | 14.4 to 29.2 |
| 3/4 | 10.2 | 20.4 to 40.8 |
| 1 | 13 | 26 to 52 |

*Note that in the above table the maximum "Amps for Starting" is more for some small motors than for larger ones. The reason for this is that the hardest starting types (split-phase) are not made in larger sizes.

Because the heavy surge of current needed for starting motors is required for only an instant, the generator will not be damaged if it can bring the motor up to speed in a few seconds. If difficulty is experienced in starting motors, turn off all other electrical loads and, if possible, reduce the load on the electric motor.

### Required Operating Speed

Although individual units may vary slightly, the normal voltage and frequency of typical 60-(50-) Hertz engine-driven generators described in this manual are approximately as follows: run first with no load applied, then at half the generator's capacity, and finally loaded to its full capacity as indicated on the generator's data plate.

See the rpm/Hertz/frequency chart on the next page.

| Load Applied | 4-Pole Speed (rpm) | Frequency (Hertz) | Generator 120V (110) Plants | Voltage 240V (220) Plants |
|---|---|---|---|---|
| None | 1830<br>(1530) | 62<br>(52) | 122<br>(112) | 240<br>(224) |
| Half | 1800<br>(1500) | 60<br>(50) | 120<br>(110) | 240<br>(220) |
| Full | 1755<br>(1455) | 59<br>(49) | 110<br>(100) | 220<br>(200) |

The output voltage should be checked periodically to ensure proper operation of the generating plant and the appliances it supplies.

If an AC voltmeter or ampmeter is not installed to monitor voltage and load, check it with a portable meter and amp-probe.

**Preventive Maintenance (Generator)**

Maintenance on the generator is minimal.

1. Keep the generator **clean, dry and well-ventilated.**

2. Ensure that all connections are clean and tight and that cables carrying AC voltage are properly supported and protected against chafing.

3. The rear armature bearing is lubricated and sealed; therefore, no maintenance is required. If the bearing becomes rough or noisy, replace it.

**Generator Troubleshooting**

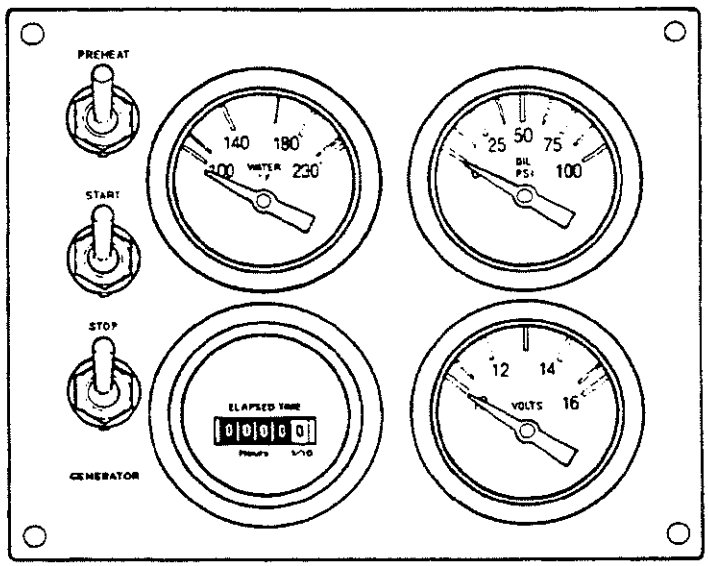
A complete and illustrated text on troubleshooting the BTD series of generators is furnished in the Technical Manual which is available through your local dealer.

## ENGINE CONTROL PANEL

### General

This manually-controlled series of Westerbeke marine diesel generators is equipped with toggle switches on the engine's control panel and, optionally, at remote panels. The following instructions and methods of correcting minor problems apply only to such toggle switch controls.

Standard Instrument Panel




All three switches are momentary contact type and serve the following functions:

1. PREHEAT: The PREHEAT toggle switch is a double-pole, single-throw switch. The switch serves two purposes: preheating the engine for easy starting and defeating or bypassing the engine's protective oil pressure sensor. The defeat function turns on the fuel solenoid, instrument power, alternator excitation and provides power to the START switch.

2. START : The START toggle switch is a double-pole, single-throw switch. The switch, when activated, energizes the starter solenoid for starting the engine. This switch will not operate electrically unless the PREHEAT switch is depressed and held at the same time.

3. STOP : The STOP toggle switch is a sinle-pole, single-throw, normally-closed switch. This switch provides power to the fuel solenoid, instrument cluster and alternator excitation, after the oil pressure switch has closed upon starting. Opening of this switch opens the power circuit to the fuel solenoid, thus stopping the flow of fuel to the engine and stopping the engine.

4. In addition to the three switches above, the Standard Instrument Panel used with Westerbeke diesel generator sets includes two gauges, which indicate water temperature in degrees Fahrenheit (WATER °F) and oil pressure in pounds per square inch (OIL PSI), and two meters, which indicate DC control circuit voltage (VOLTS) and generator running time (ELAPSED TIME) in HOURS and 1/10 hours. The Water Temperature and Oil Pressure gauges, and the DC Voltmeter are illuminated; the ELAPSED TIME meter is not.

## Engine Operation

To start the engine, perform the following steps:

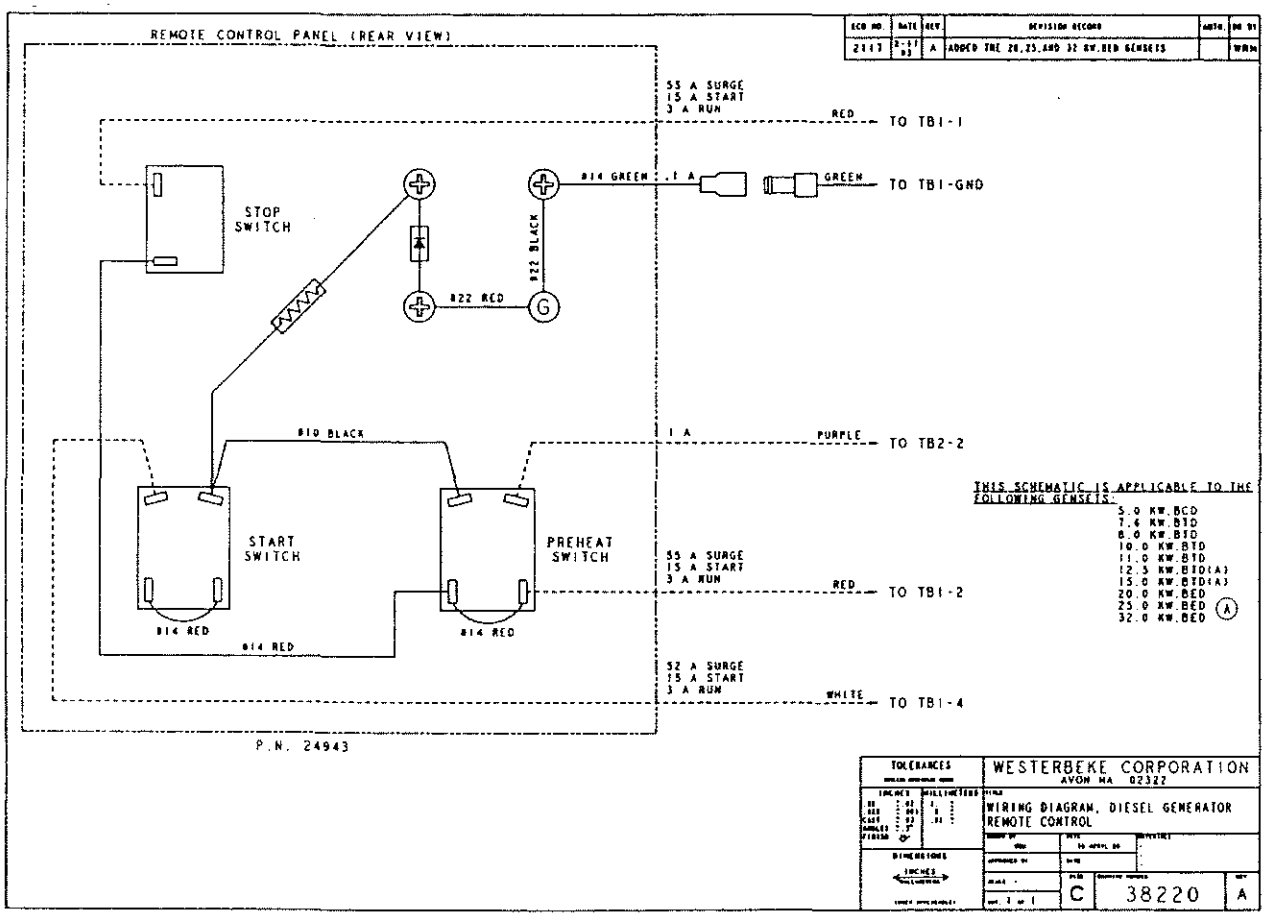
1. Preheat - Depress the PREHEAT switch. The voltmeter, panel lights, gauges and meters and fuel solenoid will be activated. The PREHEAT switch should be depressed in accordance with the chart in the "OPERATION" section under "Starting Procedure" section.

2. Start - While still depressing the PREHEAT switch, depress the START switch. This will engage the start solenoid. Panel power and the fuel solenoid will be activated. Upon engine firing, release the START switch. Do not release the PREHEAT switch until the oil pressure reaches 15 psi. Then as long as the high water temperature, low oil pressure and exhaust temperature protective circuits do not activate, the set will remain energized and continue to run.

3. Stop - Depress the STOP switch to stop the engine. This opens the power feed to the fuel solenoid, stopping the fuel flow to the engine. The STOP switch must be held depressed until the generator stops rotating.

## Remote Operation

For remote operation of the generator system, the same three switches are used. The PREHEAT and START switches are connected in parallel with the local panel's switches and serve the same functions as in the local panel. The STOP switch is in series with the local panel's STOP switch, and serves the same functions as in the local panel. The generator may be stopped from local or remote positions.



## DC WIRE SIZING CHART
### Stranded Conductors for 12 Volt Circuits
### 10% Voltage Drop

| A. Society of Automotive Engineers Type Wire | | | | | | | | | B. National Electrical Code Type Wire | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wire Size | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1 |
| Standing | 16x30 | 19x29 | 19x27 | 19x25 | 19x23 | 19x21 | 49x23 | 49x21 | 19 | 19 | 19 | 19 | 19 | 37 | 61 | 127 | 127 |
| Circular Mil Area | 1537 | 2336 | 3702 | 5833 | 9343 | 14810 | 25910 | 37360 | 2583 | 4107 | 6530 | 10380 | 16510 | 26250 | 41740 | 66370 | 83690 |
| Circuit Current in AMPS | | | Maximum Length of Conductor in Feet from Power Source to Load and Return | | | | | | | | | | | | | | |
| 1. | 174 | 260 | | | | | | | 285 | | | | | | | | |
| 2. | 87 | 130 | 210 | 330 | | | | | 142 | 227 | | | | | | | |
| 3. | 58 | 86.7 | 140 | 220 | | | | | 94.6 | 151 | 240 | | | | | | |
| 4. | 43.7 | 65 | 105 | 165 | 262 | | | | 71 | 113 | 180 | 285 | | | | | |
| 5. | 34.7 | 52 | 84 | 132 | 210 | | | | 57 | 57 | 143 | 232 | | | | | |
| 6. | 29 | 43.3 | 70 | 110 | 175 | 279 | | | 47.3 | 75.3 | 120 | 190 | 303 | | | | |
| 7. | 24.7 | 37 | 60 | 94 | 150 | 240 | | | 40.7 | 64.7 | 103 | 163 | 260 | | | | |
| 8. | 21.7 | 32.7 | 52.7 | 82.7 | 131 | 210 | | | 35.3 | 56.3 | 89.6 | 143 | 227 | | | | |
| 9. | 19.3 | 28.7 | 46.7 | 73.3 | 116 | 186 | 300 | | 31.7 | 50.3 | 79.6 | 127 | 202 | 321 | | | |
| 10. | 17.3 | 26 | 42 | 66 | 105 | 168 | 271 | | 28.3 | 45.3 | 72 | 114 | 182 | 289 | | | |
| 15. | | 17.3 | 28 | 44 | 70 | 112 | 180 | 285 | 19 | 30 | 48 | 76 | 121 | 193 | 306 | | |
| 20. | | | 21 | 33 | 52.7 | 83.7 | 135 | 211 | | 22.7 | 36 | 57 | 91 | 145 | 230 | | |
| 30. | | | | 22 | 35 | 56 | 90.3 | 142 | | | 24 | 38 | 60.7 | 96.3 | 153 | 243 | 306 |
| 40. | | | | | 26.3 | 42 | 67.3 | 107 | | | | 28.3 | 45.3 | 72 | 115 | 182 | 230 |
| 50. | | | | | 21 | 33.7 | 54 | 85.3 | | | | 23 | 36.3 | 57.7 | 92 | 146 | 184 |
| 55. | | | | | | 30.7 | 49 | 77.7 | | | | | 33 | 52.3 | 83.3 | 133 | 167 |
| 60. | | | | | | | 45 | 71.3 | | | | | | 48 | 76.3 | 121 | 153 |
| 75. | | | | | | | 36 | 57 | | | | | | 38.3 | 61 | 97.3 | 123 |
| 90. | | | | | | | | 47.3 | | | | | | | 51 | 81 | 102 |

The voltage drop for specific conductor lengths may be calculated by the formula:

$$\text{Voltage drop} = \frac{10.75 \times I \times L}{CM}$$

where: I = load in amperes
L = conductor length in feet
CM = conductor circular MIL area

When a circuit, including the ground return, uses several different size conductors, the voltage drop at the electrical device is the sum of the drops calculated for each size segment of the circuit.

## ENGINE TROUBLESHOOTING

### Introduction

The tables which follow indicate troubleshooting procedure based upon certain problem indicators, the probable causes of the problems, and the recommendations to overcome these problems.

Note that the engine's control system (electrical system) is protected by a 20-Ampere manual reset circuit breaker located on a bracket on the right side of the engine, just forward of the generator's end plate. The preheat solenoid is close by, as is the emergency STOP switch, which may be mounted on the same bracket or on the back of the standard instrument panel, depending upon the model.

## ENGINE TROUBLESHOOTING

| Problem | Probable Cause | Verification/Remedy |
|---|---|---|
| PREHEAT switch is depressed: no panel indications, fuel solenoid, electric fuel pump and preheat solenoid not energized. | Battery switch | Check switch and/or battery connections. |
| | 20-Amp circuit breaker tripped. | Reset breaker; if breaker trips again, check preheat solenoid circuit and run circuit for shorts to ground. |
| START switch is depressed: no starter engagement | Connection to solenoid faulty. | Check connection. |
| | Faulty START switch. | Check switch with ohmmeter. |
| | Faulty solenoid. | Check that 12 volts is present at solenoid connection. |
| | Loose battery connection. | Check battery connection. |
| | Low batteries. | Check battery charge state. |
| START switch is depressed: panel indication OK; start solenoid OK; fuel solenoid not functioning. | Poor connections to fuel solenoid. | Check connections. |
| | Defective fuel solenoid. | 1. Check mechanical positioning of fuel solenoid for plunger bottoming.<br>2. Manually check movement of fuel solenoid plunger and throttle arm.<br>3. Check for voltage drop at solenoid during PREHEAT. Check wire size from remote panels. |
| No ignition: cranks, but does not start; fuel solenoid energized. | Faulty fueling system. | 1. Check for fuel to generator engine.<br>2. Check for air in fuel system. Allow system to self-bleed.<br>3. Fuel lift pump faulty.<br>4. Filters clogged. (Replace filters and allow system to self-bleed by depressing only the PREHEAT switch. |

| Problem | Probable Cause | Verification/Remedy |
|---|---|---|
| Failure to stop. | Fuel solenoid return spring. | Stop engine manually by moving the throttle lever to shut off. That failing, shut off fuel and air. Check fuel solenoid linkage and repair for free movement. |
| | STOP switch failure. | Stop engine by depressing emergency STOP switch on engine or manually moving throttle to shut off. Test switch with ohmmeter. |
| | Fuel injection pump failure. | Depress emergency STOP switch on engine. Stop engine by opening the high pressure injector lines at the injectors and stop air intake. |
| Engine stops. | Low oil pressure. | Check oil level; check fresh and sea water cooling. |
| | Low oil pressure. | Check for satisfactory operation with switch depressed. Check with ohmmeter. |
| | High water temperature switch opens at too low a temperature. | Check for satisfactory operation with switch bypassed. Check with an ohmmeter. |
| | 20-Amp circuit breaker tripping. | Same as above. |
| | High exhaust temperature switch opens at too low a temperature. | Same as above. |
| | Emergency STOP switch or STOP switch in panel defective, opening fuel run solenoid circuit. | Inspect all wiring for loose connections and short circuits. Inspect switches for proper operation. |
| Battery not charging. | Alternator drive. | Check drive belt tension. Be sure alternator turns freely. Check for loose connections. Check output with voltmeter. Ensure 12 Volts present at regulator terminal. |
| Battery runs down. | Oil pressure switch. | Observe if gauges and panel lights are activated when engine is not running. Test the oil pressure switch. |

| Problem | Probable Cause | Verification/Remedy |
|---|---|---|
| Battery runs down (continued). | High resistance leak to ground. | Check wiring. Insert sensitive (0-.25 Amp) meter in battery lines. (Do not start engine.) Remove connections and replace after short is located. |
| | Low resistance leak. | Check all wires for temperature rise to locate fault. |
| | Alternator. | Disconnect alternator at output, after a good battery charging. If leakage stops, remove alternator and bench test. Repair or replace. |

## MAINTENANCE AND ADJUSTMENTS

### Introduction

This section contains a scheduled preventive maintenance program and several adjustment procedures the owner/operator can perform without the benefit of sophisticated and expensive tools and instruments.

### Preventive Maintenance (Engine)

Perform the preventive maintenance in accordance with the schedules listed in the following paragraphs. Adherence to these schedules will ensure the equipment is maintained in the best possible condition and that it will perform to expectations. Those items marked by an asterisk (*) are recommended. to be performed by an authorized dealer or distributor.

### Daily (before each use)

1. Check oil sump level. Maintain the oil level at or near upper level mark on dipstick.

2. Check coolant level in plastic recovery tank. Maintain at or above the level marked ADD.

3. Visually inspect the unit; check for loose belts, chafed or broken wires, loose brackets and fittings, damaged hoses, loose clamps, andother equipment not properly secured.

4. Check fuel supply. Fill tank(s) with a good grade of No.2 diesel fuel, if required.

5. Check the primary filter/water separator. Drain and service as required. (A primary filter/water separator is optional, but strongly recommended.)

6. Check the engine's gauges for proper oil pressure, operating temperature, and starting battery charging voltage once the engine is operating.

7. Check the generator's output meters (when installed) for proper AC voltage and output frequency.

### Monthly

Check the condition of the zinc anode in the heat exchanger's sea water circuit. Clean or replace the anode, as required. Keep the area inside the heat exchanger clean of zinc anode debris.

### Servicing After Initial 50 Hours of Operation

1. Change the engine's lube oil and oil filter.

2. Replace the fuel filter elements in the electric fuel lift pump and in the engine-mounted filter assembly.

*3. Torque the cylinder head hold-down bolts.

*4. Adjust valve clearances.

5. Adjust the alternator and water pump drive belt tension, if required.

6. Adjust the engine's no-load speed, if required (Hertz). Please note that this adjustment is not a warrantable adjustment during or after the unit's break in.

7. Lubricate the ball joint linkage between the run solenoid and the throttle arm.

**Servicing After Every 100 Hours of Operation**

1. Change the engine's lube oil and filter.

2. Adjust the alternator and water pump drive belt tension, if required.

3. Lubricate the ball joint linkage between the run solenoid and the throttle arm.

4. Inspect siphon-break assembly for proper operation (when installed).

**Servicing After Every 250 Hours of Operation**

Replace the fuel filter elements in the electric fuel lift pump and in the engine-mounted filter assembly.

**Servicing After Every 500 Hours of Operation**

*1. Torque the cylinder head hold-down bolts.

*2. Adjust the valve clearances.

3. Drain, flush, and refill the fresh water cooling system. For an illustration showing the heat exchanger and block drain locations, see model photos with callouts at the beginning of this manual.

*4. Check the condition of the starter motor drive pinion; lubricate pinion.

5. Check the resistance of the glow plus. Check circuit operation. 1.0 - 1.2 ohms.

6. Check raw water pump for internal wear. Examine the pump's cover, cam and internal housing. Replace worn parts as needed. Check for leaks at seals or gaskets and make repairs as needed. Do not neglect.

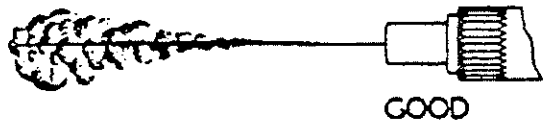
7. Check external and internal condition of the water injected exhaust elbow. Inspect exhaust and water passages in the elbow. Remove any carbon and/or corrosion build up. Replace the elbow should its condition be questionable.

**Servicing After Every 800 Hours of Operation**

*1. Remove and check fuel injectors.


Injector spray pressure:

1706 psi + 142 psi
(120 kg/cm$^2$ + 10 kg/cm$^2$)




Eliminate undesirable injection conditions including after dripping.

*2. Check compression pressure. Remove each glow plug and check each cylinder's compression pressure. The engine's cranking speed is at 250 rpm.

8.0 KW, 10.0 KW, 11.0 KW, 12.5 KW

| Standard | Minimum |
|---|---|
| 455 psi (32 kg/cm$^2$) | 370 psi (26 kg/cm$^2$) |

(Maximum difference between cylinders: 35.5 psi (2.5 kg/cm$^2$)

*3. Check the battery-charging alternator for proper operation.

*4. Check the tightness of bolts, nuts, and clamps.

**Servicing After Every 1000 Hours of Operation**

1. Remove, clean, and pressure test the primary heat exchanger. (A local automotive radiator shop should be able to clean and test the heat exchanger.

*2. Check the injection pump's timing.

**Preventive Maintenance (Generator)**

Maintenance on the generator end is minimal:

1. Keep the generator **clean, dry and well-ventilated.**

2. Ensure that all connections are clean and tight, and that cables carrying AC voltage are properly supported and protected against chafing.

*3. The rear armature bearing is lubricated and sealed; no maintenance is required. However, if the bearing becomes noisy or rough-sounding, have it replaced.

ADJUSTMENT OF VALVE CLEARANCE
MODEL: BTD 8.0KW & 10.0 KW

***CAUTION***

Adjust the valve clearance when the engine is cold.
0.010 inches (0.25 mm)

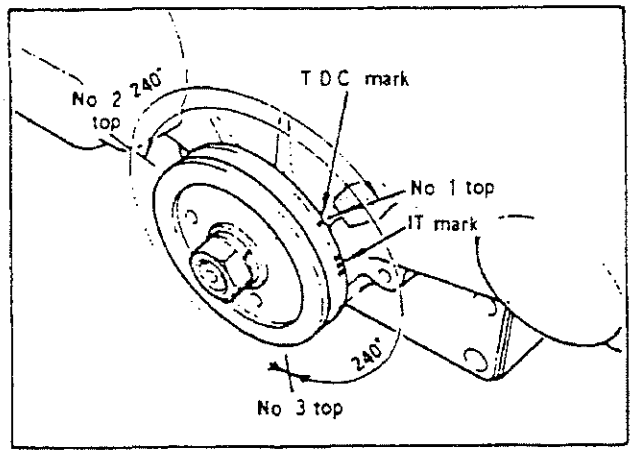
Tighten the cylinder head bolts to the specified torque.

1. Pull off the air breather pipe from the rocker cover, and take off the rocker cover bolts. Adjust the valve clearances at TDC (Top Dead Center) for each cylinder when they are on their compression stroke (see below).

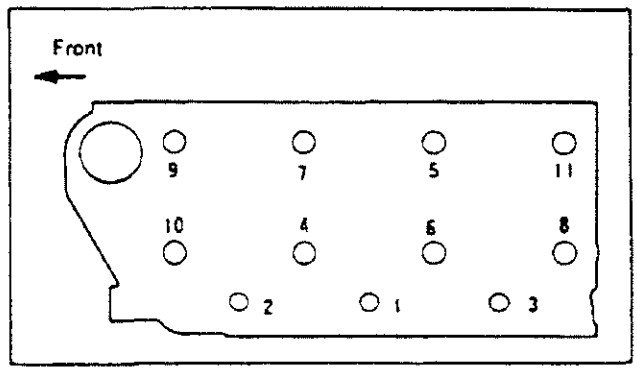
2. Align the timing marks on the gear case and on the crankshaft pulley as shown. In this position, the No.1 cylinder is at its top Timing Mark while dead center on its compression stroke. Check both intake and exhaust valve clearances of the cylinder. If the valves have no specified clearance, adjust by means of the adjusting screws. Remember to align the timing marks properly; if not, the valve may be pushed up by the piston, depending on position of the cam lobe.

3. Next, the piston of No. 3 cylinder comes TDC. Turn the crankshaft 240° clockwise from the above position, aligning the timing mark of the crankshaft with that of the gear case. Then check and adjust the valve clearance.

4. To check the No. 2 cylinders valve clearance, turn the crankshaft another 240° clockwise, and then align the timing marks; check and adjust the valve clearance in a similar manner.




Timing Mark




3 Cylinder Head Bolt Tightening Sequence

Note: Retighten the cylinder head bolts before the valve clearance is adjusted. Note: mm size shown are sockets size for holddown bolts. Rocker Shaft Holddown Bolts: (14mm 3.4 kg-m) 24.5 ft-lbs.

BTD 8.0 KW and 10.0 KW
Bolts #4,5,6,7,8,9,10 & 11
(17 mm 11-12.5 kg-m)
83.2 - 90.4 ft-lbs
Bolts #1,2, & 3
(14 mm 6.5 - 8 kg-m)
47.0 - 57.9 ft-lbs

ADJUSTMENT OF VALVE CLEARANCE
MODEL: BTD 11.0 KW & BTD (A) 12.5 KW

***CAUTION***

Adjust the valve clearance when the engine is cold.
0.010 inches (0.25 mm)

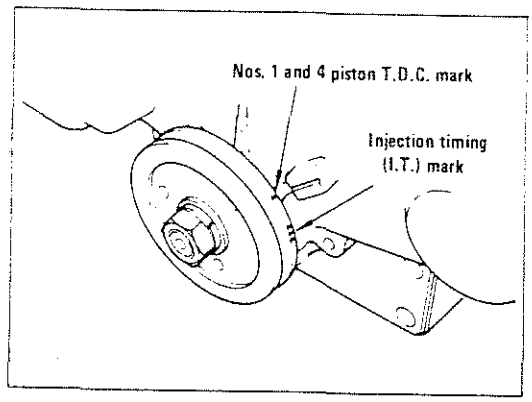
Tighten the cylinder head bolts to the specified torque.

1. Pull off the air breather pipe from the rocker cover, and take off the rocker cover bolts.

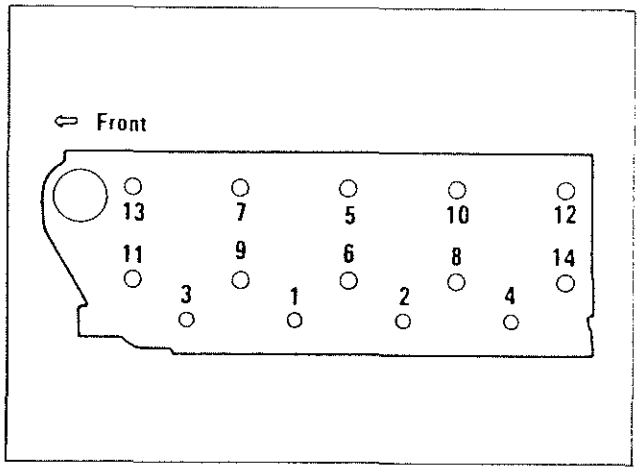
2. Adjust the valve clearances at TDC (Top Dead Center) for each cylinder when they are on their compression stroke.

3. Make sure that the timing mark on the gear case and the timing mark on the crankshaft pulley are exactly aligned; if not, the valve will interfere with the piston because of improper cam positioning. (Refer to page 71 another illustration showing crankshaft timing marks.)

NOTE: Retighten the cylinder head bolts before the valve clearance is adjusted.




Timing Mark




Cylinder Head Bolts Tightening Sequence

BTD 11.0KW & BTDA 12.5KW
BOLTS 5,6,7,8,9,10,11,12,13&14
(17MM 11.5 - 12.5 kg/m)
83.1 - 86.7 ft-lbs
BOLTS 1,2,3, & 4
(14MM 6.5 - 8.0 kg/m)
47.0 - 57.8 ft-lbs

BTD 12.5KW
BOLTS 5,6,7,8,9,10,11,12,13 &14
(22MM 15-16 kg/m)
108.4 - 115.7 ft-lbs
BOLTS 1,2,3, & 4
(22MM 11-12 kg/m)
79 - 86 ft-lbs

NOTE: mm size shown are socket size for holddown bolts

BTD 11.0KW & BTDA 12.5 KW
Rocker Shaft Holddown Bolts
14mm (4.0-5.5 kg/m) 28.9 - 39.8 ft-lbs
10mm (0.8-1.2 kg/m) 5.8 - 8.7 ft-lbs

BTD 12.5 KW
Rocker Shaft Holddown Bolts
14mm (4.0-5.5 kg/m)28.9-39.8ft-lbs
10mm (0.8-1.2 kg/m) 5.8 - 8.7 ft-lbs

**Revised**
**August 1994**

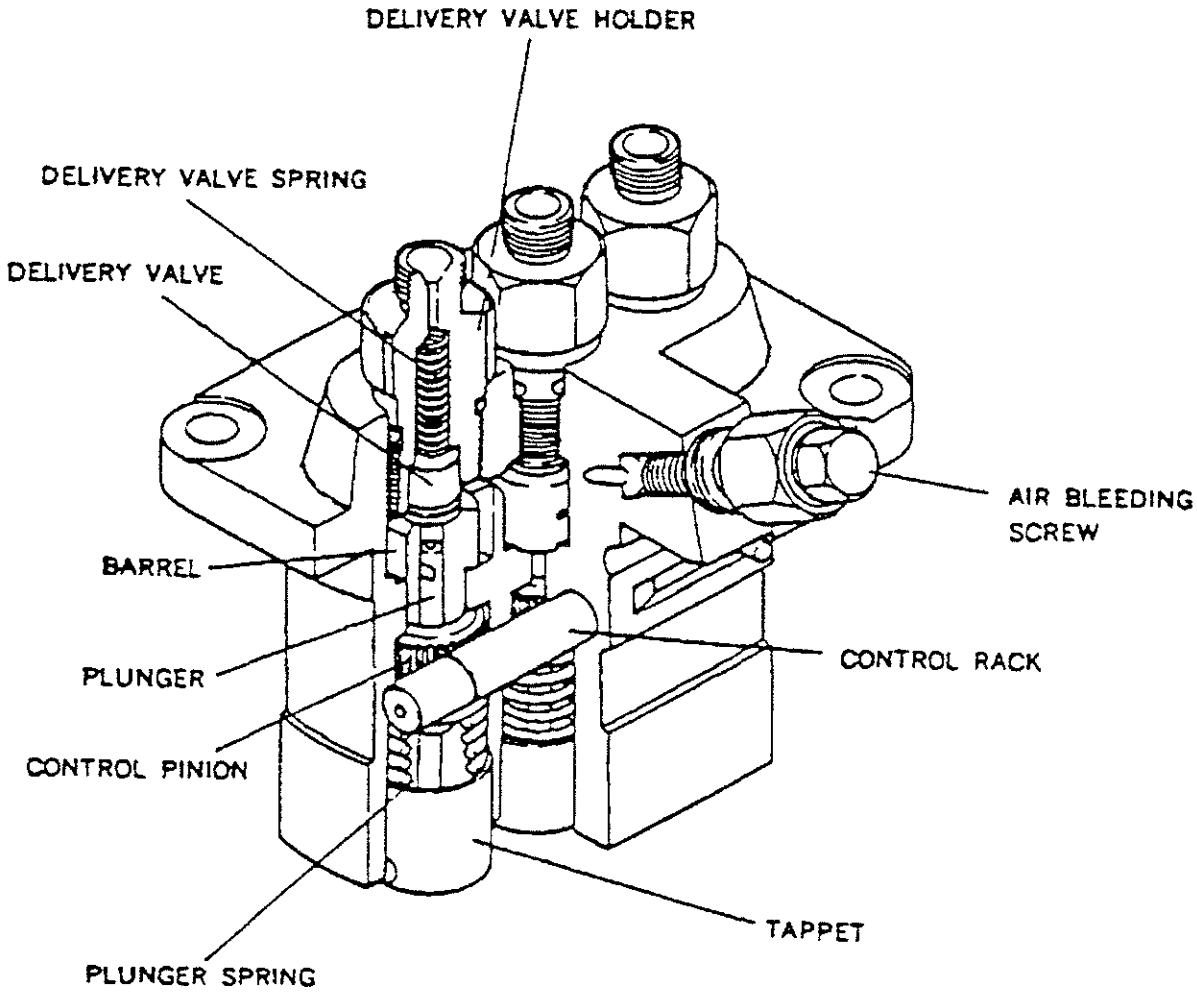
Injection Timing Adjustment (BTD 8.0KW, 10.0KW, 11.0KW & 12.5KW)

Incorrect fuel injection timing will result in hard engine starting and poor engine performance. Adjust the injection timing as follows:

> NOTE: The fuel lever (throttle) must be in the Run position while making the adjustment or no fuel will flow to the fuel injection pump.

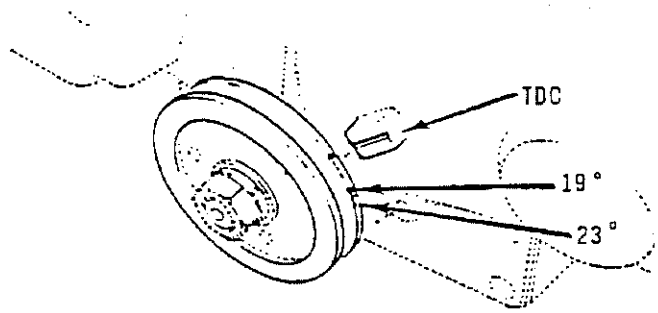
Refer to the cutaway view of the fuel injection pump and remove the high-pressure fuel line from the No. 1 fuel delivery valve holder. Remove the No.1 fuel delivery valve holder and remove the delivery valve spring beneath the holder. Reinstall the delivery valve holder and reattach the fuel line. Disconnect the opposite end of the No. 1 fuel line (from the No. 1 fuel injector) and turn the fitting away from the injector, in order to catch the fuel as the pump operates.

Rotate the crankshaft clockwise (as viewed from the front), catching the fuel from the No. 1 fuel line, until the instant the fuel completely stops flowing (no drips). At this instant, the 19° BTDC timing mark on the crankshaft pulley should be directly aligned with the timing indicator on the front of the cylinder block (see the illustration on the next page).




Cutaway View of 3-Cylinder Fuel Injection Pump

If the specified (19° BTDC) injection timing cannot be attained, adjust the timing by increasing or decreasing the thickness of the injection pump mounting shim. Changing the shim thickness by 0.004 inch (0.01mm) changes the injection timing by approximately one degree. To advance the timing, decrease the shim thichness, as required. To retard the timing, increase the shim thickness, as required.




Crankshaft Pulley Timing Marks

**Adjustments (Generator)**

Once the diesel generator set has been placed in operation, there may be adjustments required for engine speed (Hertz) during the engine's break-in period (first 50 hours) or after this period. A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment.

***CAUTION***

When starting the generator, it is recommended that all AC loads, especially large motors, be switched OFF until the engine has come up to speed and, in cold climates, starts to warm up. This precaution will prevent damage caused by unanticipated operation of AC machinery and will prevent a cold engine from stalling.

**Generator Frequency Adjustment**

Frequency is a direct result of engine/generator speed, as indicated by the following:

When the generator is run at 1800 rpm, the AC voltage output frequency is 60 Hertz. When the generator is run at 1500 rpm, the AC voltage output frequency is 50 Hertz.

Therefore, to change the generator's frequency, the generator's speed must be changed. To accomplish the frequency change, perform the following:

1. Connect the AC output leads to the AC terminal block in accordance with the AC Voltage Connections diagram specified for your generator set, which appears in the "BT GENERATOR" section of this manual.

2. Adjust the engine's speed to obtain the frequency corresponding to the voltage selected by extending or shortening the Throttle Adjustment Linkage. Make sure the solenoid's plunger is completely bottomed in the solenoid. (See figure below.)

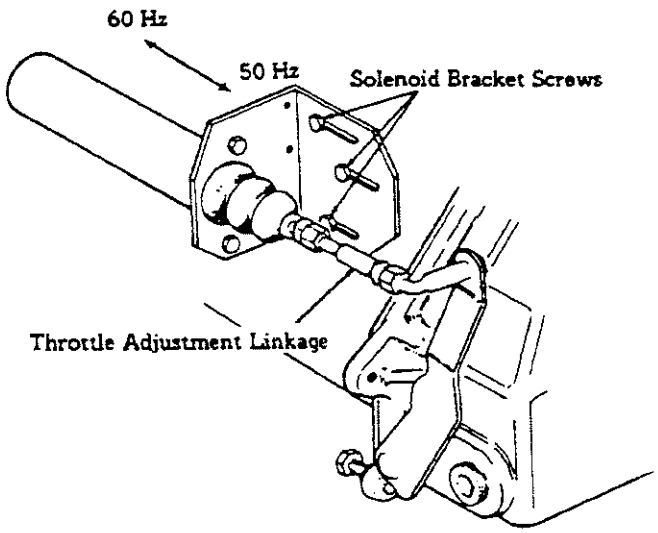
***CAUTION***

Failure of the solenoid to bottom in the solenoid will result in a failed solenoid.

To avoid failure of the solenoid, ensure that the solenoid plunger bottoms in the solenoid. Check the solenoid's operation at the initial start-up. Periodically lubricated linkage joints between the solenoid plunger and the throttle arm will eliminate binding.

NOTE: The solenoid plunger *must* move smoothly and rapidly into the solenoid when the solenoid is electrically energized, drawing the engine's throttle arm into the Set Speed/Run position.

To arrive at the appropriate frequency, either monitor the speed of the engine/generator with a tachometer, or monitor the frequency with a frequency meter, the latter method being the more precise of the two.




Solenoid and Throttle with Linkage
BTD 8.0KW, 10.0KW, 11.0KW & 12.5 KW

## LAY-UP AND RECOMMISSIONING

### General

Many owners rely on their boatyards to prepare their craft, including engines and generators, for lay-up during the off-season or for long periods of inactivity. Others prefer to accomplish lay-up preparation themselves.

The procedures which follow will allow you to perform your own lay-up and recommissioning, or to use as a check list if others do the procedures.

These procedures should afford your engine protection during a lay-up and also help familiarize you with the maintenance needs of your engine.

If you have any questions lay-up procedures, call your local servicing dealer; he will be more than willing to provide assistance.

### Fresh Water Cooling System

A 50-50 solution of antifreeze and fresh water is recommended for use in the fresh water cooling system at all times. This solution may require a higher concentration of antifreeze, depending on the area's winter climate. Check the solution to ensure that the antifreeze protection is adequate.

Should more antifreeze be needed, drain an appropriate amount from the engine block and add a more concentrated mixture. Operate the engine to ensure a complete circulation and mixture of the antifreeze concentration throughout the cooling system. Now recheck the antifreeze solution's strength.

### Lubrication System

With the engine warm, drain all the lubricating oil from the oil sump. Remove and replace the oil filter. (Place some paper towels and a plastic bag around the filter to catch the oil during its removal.)

When installing the new oil filter, be sure to apply a small amount of oil on the rubber sealing gasket at the base of the filter. Fill the sump with the correct amount of oil for your engine model. (Refer to the "SYSTEM SPECIFICATIONS" section of this manual for the amount of oil each model's oil sump should contain.) Use an oil with an API specification of CC-CD, Run the engine, check for proper oil pressure and ensure there are no leaks.

*CAUTION*

Do not leave the engine's old lubricating oil in the sump over the lay-up period. Lubricating oil and combustion deposits combine to produce harmful chemicals which can reduce the life of your engine's internal parts.

**Fuel System**

Top off your fuel tanks with No. 2 diesel fuel. Fuel additives should be added at this time to control algae and condition the fuel. Care should be taken that the additives used are compatible with the primary filter/water separator used in the system. Change the element in your primary fuel filter/water separator, if the fuel system contains one, and clean the separator sediment bowl.

Change the fuel filter elements on the engine and bleed the fuel system, as needed. Start the engine and allow it to run for 5 - 10 minutes to ensure that no air is left in the fuel system. Check for any leaks that may have been in the fuel system during this servicing, correcting them as needed.

**Sea Water Circuit**

Close the thru-hull seacock. Remove the sea water intake hose from the seacock. Place the end of this hose into a 5-gallon bucket of clean fresh water. Before starting the engine, check the zinc anode found in the primary heat exchanger on the engine and clean or replace it as required. Clean the sea strainer, if one is installed in the inside of the hull.

Start the engine and allow the sea water pump to draw fresh water through the system. When the bucket is empty, stop the engine and refill the bucket with an antifreeze solution slightly stronger than needed for winter freeze protection in your area.

Start the engine and allow all of this mixture to be drawn through the sea water system. Once the bucket is empty, stop the engine. This antifreeze mixture should protect the sea water circuit from freezing during the winter lay-up, as well as providing corrosion protection.

Remove the impeller from your sea water pump (some antifreeze mixture will accompany it, so catch it in a bucket). Examine the impeller. Acquire a replacement, if needed, and a cover gasket. Do not replace the impeller (into the pump) until recommissioning, but replace the cover and gasket.

**Intake Manifold and Through-Hull Exhaust**

Place a clean cloth, lightly soaked in lubricating oil, in the opening of the intake manifold to block the opening. Do not shove the cloth out of sight. (If it is not visible at recommissioning, and an attempt is made to start the engine, you may need the assistance of a servicing dealer.) Make a note to remove the cloth prior to start-up. The through-hull exhaust part can be blocked in the same manner.

**Starter Motor**

Lubrication and cleaning of the starter drive pinion is advisable, if access to the starter permits its easy removal. Ensure that the battery connections are shut off before attempting to remove the starter. Take care in properly replacing any electrical connections removed from the starter.

**Cylinder Lubrication**

It is not necessary to remove the glow plugs from the cylinder head to squirt light lubricating oil into the cylinders for the few months of normal lay-up. However, if you anticipate a longer lay-up period (12 months or more), we recommended that this procedure be performed. The light oil in the cylinders will prevent the piston rings from sticking to the cylinder walls. Apply a small amount of anti-seize to the glow plugs threads when reinstalling.

**Spares**

Lay-up time provides a good opportunity to inspect the equipment to see if external items such as drive belts or coolant hoses need replacement. Check your basic spares kit and order items not on hand, or replace those items used during the lay-up, such as filters and zinc anodes.

**Batteries**

If batteries are to be left on board during the lay-up period, ensure that they are fully charged, and will remain that way, to prevent them from freezing. If there exists any doubt that the batteries will no remain fully charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

**Recommissioning**

The recommissioning of your Westerbeke unit after a seasonal lay-up generally follows the same procedures as those presented in the "Preparation for Starting" section, regarding preparation for starting and normal starts. However, some of the lay-up procedures will need to be counteracted before starting the engine.

1. Remove the oil-soaked cloths from the intake manifold and from the through-hull exhaust port.

2. Remove the sea water pump cover and gasket. Discard the gasket. Install the sea water pump impeller removed during lay-up (or a replacement, if required). Install the sea water pump cover with a new cover gasket.

***WARNING***

Wear rubber gloves, a rubber apron, and eye protection when servicing batteries.

Lead acid batteries emit hydrogen, a highly-explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.

3. Reinstall the batteries that were removed during the lay-up, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to ensure that the batteries are fully charged.

4. Check the condition of the zinc anode in the sea water circuit and clean or replace the anode as needed. Note that it is not necessary to flush the antifreeze/fresh water solution from the sea water coolant system. When the input is put into operation, the system will self-flush in a short period of time with no adverse effects.

5. Start the unit in accordance with procedures in the "Preparation for Starting" section of this manual.

# TABLE OF STANDARD HARDWARE TIGHTENING TORQUES

Unless stated otherwise for a specific assembly, use the following torque values when tightening standard hardware.

| | Pitch | lb-ft | kg-m |
|---|---|---|---|
| Grade 4 | | | |
| 6mm bolt head/nut | 1 | 2.9 - 5.1 | 0.4 - .07 |
| 8mm bolt head/nut | 1.25 | 7.2 - 11.61.0 - 1.6 | |
| 10 mm bolt head/nut | 1.25 | 13.7 - 22.4 | 1.9 - 3.1 |
| 10 mm bolt head/nut | 1.5 | 13.0 - 21.7 | 1.8 - 3.0 |
| 12 mm bolt head/nut | 1.25 (ISO) | 25.3 - 39.8 | 3.5 - 5.5 |
| 12 mm bolt head/nut | 1.5 | 25.3 - 39.8 | 3.5 - 5.5 |
| 12 mm bolt head/nut | 1.75 | 21.7 - 36.2 | 3.0 - 5.0 |
| 13 mm bolt head/nut | 1.5 | 32.5 - 50.6 | 4.5 - 7.0 |
| 14 mm bolt head/nut | 1.5 | 36.2 - 57.9 | 5.0 - 8.0 |
| 14 mm bolt head/nut | 2 | 34.0 - 55.7 | 4.7 - 7.7 |
| 16 mm bolt head/nut | 1.5 | 54.2 - 79.6 | 7.5 - 11.0 |
| 16 mm bolt head/nut | 2 | 51.4 - 76.7 | 7.1 - 10.6 |
| Grade 6T | | | |
| 6mm bolt head/nut | 1 | 4.3 - 6.5 | 0.6 - 0.9 |
| 8mm bolt head/nut | 1.25 | 10.8 - 15.9 | 1.5 - 2.2 |
| 10 mm bolt head/nut | 1.25 | 21.7 - 32.5 | 3.0 - 4.5 |
| 10 mm bolt head/nut | 1.5 | 19.5 - 30.4 | 2.7 - 4.2 |
| 12 mm bolt head/nut | 1.25 (ISO) | 36.2 - 57.9 | 5.0 - 8.0 |
| 12 mm bolt head/nut | 1.5 | 36.2 - 50.6 | 5.0 - 7.0 |
| 12 mm bolt head/nut | 1.75 | 34.7 - 49.2 | 4.8 - 6.8 |
| Grade 7T, 8T and 8.8 | | | |
| 6mm bolt head/nut | 1 | 5.8 - 8.7 | 0.8 - 1.2 |
| 8mm bolt head/nut | 1.25 | 14.5 - 21.7 | 2.0 - 3.0 |
| 10 mm bolt head/nut | 1.25 | 28.9 - 39.8 | 4.0 - 5.5 |
| 10 mm bolt head/nut | 1.5 | 26.8 - 37.6 | 3.7 - 5.2 |
| 12 mm bolt head/nut | 1.25 (ISO) | 54.2 - 75.9 | 7.5 - 10.5 |
| 12 mm bolt head/nut | 1.5 | 50.6 -65.1 | 7.0 - 9.0 |
| 12 mm bolt head/nut | 1.75 | 43.4 -61.5 | 6.0 - 8.5 |
| 13 mm bolt head/nut | 1.5 | 57.9 - 86.8 | 8.0 - 12.0 |
| 14 mm bolt head/nut | 1.5 | 72. 3 - 108.5 | 10.0 - 15.0 |
| 14 mm bolt head/nut | 2 | 68.7 - 101.3 | 9.5 - 14.0 |
| 16 mm bolt head/nut | 1.5 | 108.5 - 166.4 | 15.0 - 23.0 |
| 16 mm bolt head/nut | 2 | 101.3 - 159.1 | 14.0 - 22.0 |
| Grade 5 cap screw | | | |
| 1/4 UNC | | 9 - 11 | 1.2 - 1.5 |
| 1/4 UNF | | 11 - 13 | 1.5 - 1.8 |
| 5/16 UNC | | 18 - 20 | 2.5 - 2.8 |
| 5/16 UNF | | 21 - 23 | 2.9 - 3.2 |
| 3/8 UNC | | 28 - 33 | 3.7 - 4.6 |
| 3/8 UNF | | 30 - 35 | 4.1 - 4.8 |
| 7/16 UNC | | 44 - 49 | 6.1 - 6.8 |
| 7/16 UNF | | 50 - 55 | 6.9 - 7.6 |
| 1/2 UNC | | 68 - 73 | 9.4 - 10.1 |
| 1/2 UNF | | 73 - 80 | 10.1 - 11.1 |

TABLE OF TIGHTENING TORQUES
FT - LBS (KG - M)

| | 8.0 & 10.0 BTD | 12.5 BTD | 11.0 BTD AND 12.5 BTDA |
|---|---|---|---|
| Crankshaft Pulley Nut | 108.5-144.7 (15-20) | 144.6-180.8 (20-25) | 108.5-144.7 (15-20) |
| Main bearing cap bolt | 36.2-39.8 (5.0-5.5) | SAME | SAME |
| Connecting rod cap nut | 23.1-25.3 (3.2-3.5) | 39.7-43.3 (5.5-6.0) | 23.1-25.3 (3.2-3.5) |
| Flywheel bolt - with separate washers | 83.2-90.4 (11.5-12.5) | SAME | SAME |
| Flywheel bolt - washer attached | 94.0-101.3 (13.0-14.0) | SAME | SAME |
| Oil pan drain plug | 36.2-43.4 (5.0-6.0) | SAME | SAME |
| Oil filter | 8.0-9.4 (1.1-1.3) | SAME | SAME |
| Delivery valve holder (injection pump) | 28.9-36.2 (4.0-5.0) | SAME | SAME |
| Holder mounting bolt, nozzle | 10.8-14.5 (1.5-2.0) | SAME | SAME |
| Holder body and retaining nut, nozzle | 43.4-57.9 (6.0-8.0) | SAME | SAME |
| Glow plug | 10.8-14.5 (1.5-2.0) | SAME | SAME |

## SOUND GUARD INSTALLATION INSTRUCTIONS

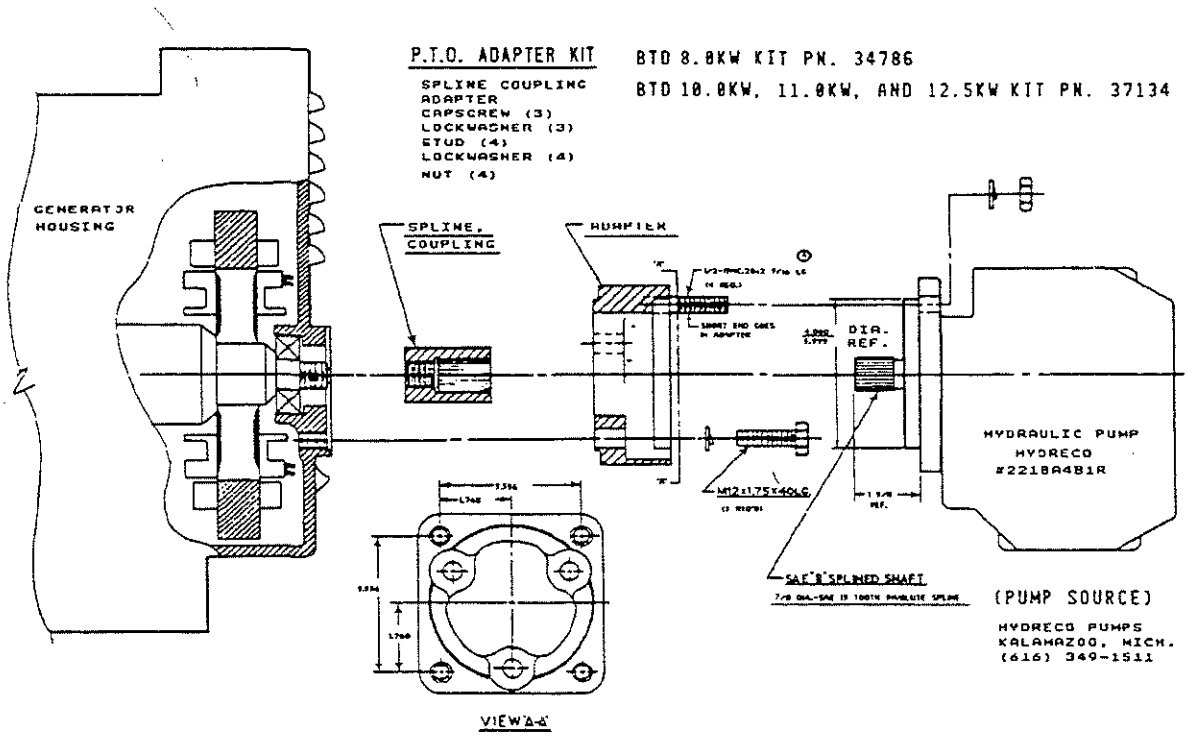
For a copy of the Sound Guard installation instructions required for your generator set, please contact your local Westerbeke dealer. A four page installation brochure is available which covers all current Sound Guard model assembly/installations.

## POWER TAKE-OFF (PTO) ADAPTER KITS

The generator housing of the Generators is machined to accept an optional power take-off (PTO) adapter kit. This kit allows the user to mount and to operate a hydraulic pump (or similar device) while the generator is operating.

The operator is advised that the generator's drive engine produces a specific amount of horsepower at 1800 rpm. This horsepower can be utilized either for generator AC amperage output or to operate the PTO device. It cannot do both; that is, it cannot produce AC amperage and furnish horsepower to operate the PTO device, simultaneously.

When mounting a PTO device using the optional adapter kit listed below, ensure good alignment of the device to the spline coupling and ensure that if additional support is needed, it is added. When in doubt, provide extra support.




NOTE: Provisions should be made to prevent the PTO device from overloading the generator's engine. Install a pressure relief valve on the hydraulic pump to limit maximum pumping pressure.